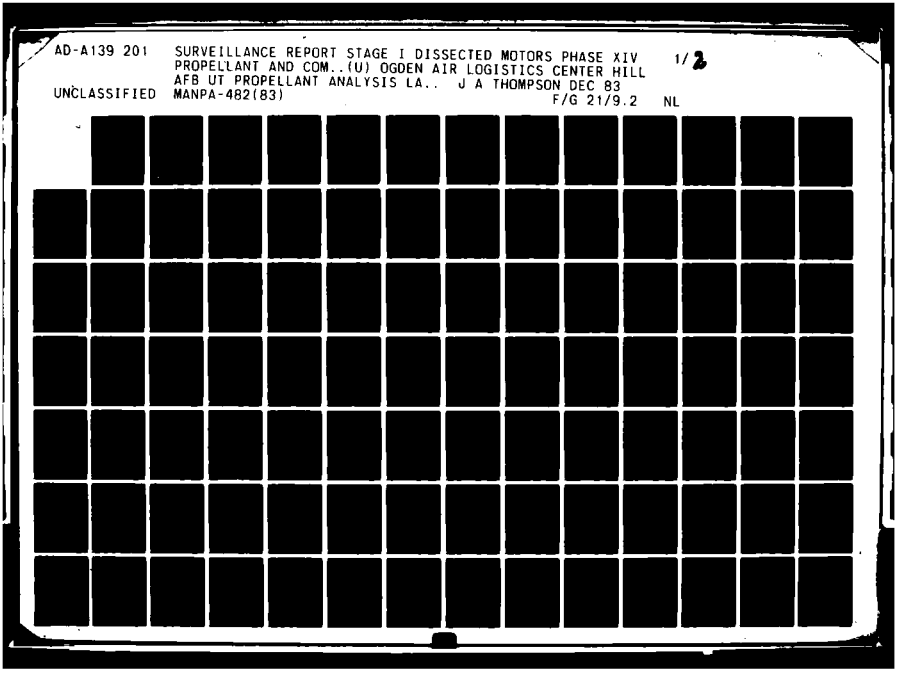
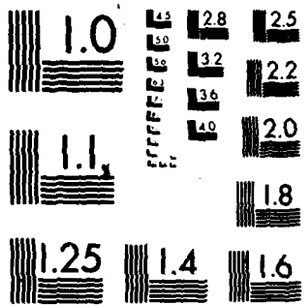
AD-A139 201 SURVEILLANCE REPORT STAGE I DISSECTED MOTORS PHASE XIV PROPELLANT AND COM..(U) OGDEN AIR LOGISTICS CENTER HILL AFB UT PROPELLANT ANALYSIS LA.. J A THOMPSON DEC 83 1/2

UNCLASSIFIED MANPA-482(83) F/G 21/9.2 NL





HEADQUARTERS

OGDEN AIR LOGISTICS CENTER

UNITED STATES AIR FORCE

HILL AIR FORCE BASE, UTAH 84056

SURVEILLANCE REPORT
STAGE I
DISSECTED MOTORS
PHASE XIV

PROPELLANT ANALYSIS LABORATORY

MANPA REPORT NR
482(83)

DECEMBER 1983

MANPA REPORT NR 482(83)
MMWRM PROJECT M34929C

SURVEILLANCE REPORT

STAGE I DISSECTED MOTORS

PHASE XIV PROPELLANT & COMPONENT TESTING

Author

JOHN A. THOMPSON, Chemist
Component and Combustion Test Unit

Engineering & Statistical Review By

JOHN K. SCAMBIA, Project Engineer
Service Engineering

EDWARD J. ERICKSON, Statician
Data Analysis Unit

Recommended Approval By

DAN L. PETERSEN, Chief
Propellant & Analysis Test Units

Approved By

ANTHONY J. INVERSO, Chief
Propellant Analysis Laboratory

December 1983

Ind Products & Ldg Gear Division
Directorate of Maintenance
Ogden Air Logistics Center
United States Air Force
Hill Air Force Base, Utah 84056

A-1

ABSTRACT

Testing was performed to determine the useful shelf/service life for LGM-30 Stage I Rocket Motors. A three year storage program for propellant and components was started in May 1961. This program was then extended to a ten year study and later continued indefinitely to assure that a deterioration in motor physical characteristics could be detected in time to take some corrective actions before the weapon system performance deteriorated below an acceptable level.

This report covers only propellant data and limited case bond data. The malfunction of an environmental chamber destroyed component samples that had originally been part of this testing program (and the inadvertent burning of some motors during dissection reduced the material available for testing). Planned dissection of selected motors in the future will provide samples for continued component testing. Test specimens for this reporting period were obtained from motors STM-012, 0012099, and 0012199. UP-7775 block propellant was not tested since that propellant has been used up.

A new technique of Multi-symbol Regression Analysis was used to determine aging trends. Also, using a unique plotting code for each motor tested demonstrates the relationship between motors and block propellant. The plotting symbols for each motor and block propellant are listed in the statistical analysis section.

The data from this test period was combined with data from previous testing and entered into the G085 computer for storage, analysis, and regression analysis. From the statistical analysis of all data tested to date, significant degradation of the propellant does not appear likely for at least two years past the oldest data point.

Future testing will be conducted on dissected motors.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES (cont)

LIST OF FIGURES (cont)

LIST OF FIGURES (cont)

LIST OF FIGURES (cont)

GLOSSARY OF TERMS AND ABBREVIATIONS

Aging Trend	A change in properties or performance resulting from aging of material or component
CSA	Cross Sectional Area
DB	Dogbone
Degradation	Gradual deterioration of properties or performance
E	Modulus (psi), defined as stress divided by strain along the initial linear portion of the curve.
EB	End Bonded
EGL	Effective Gage Length
em	Strain at maximum stress
er	Strain at rupture
"F" ratio	The ratio of the variance accounted for by the regression function to the random unexplained variance. The regression function having the most significant "F" ratio is used for plotting data. The ratio is also used in detecting significant changes in random variation between succeeding time points
JANNAF	Joint Army, Navy, NASA, Air Force Committee
MANPA	Propellant Lab Section at Ogden Air Logistics Center
Ogden ALC	Ogden Air Logistics Center, Air Force Logistics Command
r or R	The Correlation Coefficient is a measure of the degree of closeness of the linear relationship between two variables
Regression Equation	The general form of the regression equation is $Y = a + bx$
Regression Line	Line representing mean test values with respect to time
S_b	Standard error of estimate of the regression coefficient

GLOSSARY OF TERMS AND ABBREVIATIONS (cont)

S_e or $S_{Y.X}$	Standard deviation of the data about the regression line
Sm	Maximum Stress
Sr	Stress at rupture
Standard Deviation (S_y)	Square root of variance
Strain Rate	Crosshead speed divided by the EGL
"t" test	A statistical test used to detect significant differences between a measured parameter and an expected value of the parameter (determines if regression slope differs from zero at the 95% confidence level)
Variance	The sum of squares of deviations of the test results from the mean of the series after division by one less than the total number of test results
3 Sigma Band	The area between the upper and lower 3 sigma limit. It can be expected that 99.73% of the inventory represented by the test samples would fall within this range assuming that the population is normally distributed.
90-90 Band	It can be stated with 90% confidence that 90% of the inventory represented by the test samples would fall within this range assuming that the population is normally distributed

INTRODUCTION

A. PURPOSE:

This report contains test data from samples of LGM-30 Stage I, Wings I-V TP-H1011 propellant and case bond specimens. Testing was performed by the Propellant Analysis Laboratory (MANPA) for the Engineering and Relaibility Branch of the Airmunitions Management Division (MMWRM) under Project M34929C. This report is the fourteenth in this series. Data from this test period and propellant test data from the thirteen previous reports were entered into the G085 computer for regression analysis. The regressions are shown in this report.

B. TEST PROGRAM:

The LGM-30 laboratory and component program includes the testing of materials used in the main case and main grain propellant. Table 1 outlines the test program.

Propellant for testing was obtained from three dissected motors; STM-012, a motor prepared by Thiokol specifically for dissection, S/N 0012099, a SLIM motor and S/N 0012199 which was selected for dissection.

C. HISTORICAL BACKGROUND:

In May 1961, Thiokol began a three year LGM-30 laboratory storage and test program to determine the rate of degradation with age for Stage I materials. During June 1962 and again in August 1963, additional samples were included. New samples were added in July and August 1964 when the surveillance test program was extended to ten years (Test Plan 0717-62-0967, 53-8). The samples added to the inventory in 1964 were considered to be a new population, but were combined in regression analysis with the three dissected motors.

The history of testing of these materials is found in MQQP Report Nrs. 109A(67), 144(68), 208(71) and MANCP Report Nr. 358(76). Physical transfer of the specimens from Thiokol to Ogden ALC was made in June 1967.

Until 1982, due to a limited number of dissected motor samples, data from all motors were combined for statistical analyses. In 1982, key LRSLA parameters were also reported for the individual motors (MANPA Report Nr. 470(82). The statistical approach for this report is the same as in report 470(82).

For the next test phase all motors will be reported individually with no combined data grouped together. For motors STM-012 and 0012099, the next report will be the final report. Only motor 0012199 has sufficient assets for continued testing.

STATISTICAL ANALYSIS

The objective of this statistical analysis was to determine whether or not any aging trends are demonstrated by accumulated test data in order to assist Service Engineering to more accurately predict motor serviceability.

Propellant was made available for testing and statistical analysis was performed on the resultant data in order to obtain an overall view of the aging trends affecting the Stage I Dissected Motor Program. The sampling consisted of data from two dissected operational motors (0012099 and 0012199), and one motor (STM-012) was prepared by Thiokol specifically for the dissection program. By using TP-H1011 propellant from Stage I Dissected Motors, a normal distribution population was assumed and the data from these motors were statistically combined.

A new technique of Multi-symbol Regression Analysis Program was used to determine aging trends. The sampling is combined for each test parameter in a single regression analysis. The linear equation ($Y = a + bX$) was found to be the best fit model for the data in this report. A composite population aging regression trend line is then calculated.

The Multi-symbol program uses a unique plotting code for each motor data on the regression plots. The method of data plotting allows a visual display of the overall relationship between different motors and how they relate to the overall least square aging trend line.

The regression program uses an analysis with individual data points from different time periods combined to establish a least squares aging trend line for the overall data. The variance about the regression line, obtained using individual values of the dependent variable, was used to compute a tolerance interval such that at the 90% confidence level 90% of the population falls within this interval. This tolerance interval was

extrapolated to a maximum of 24 months to give an indication of the statistical significance of the slope of any aging trends. The computer tolerance interval about the composite regression line is wider than what the tolerance interval would be about any individual motor regression line because of the increased data spread introduced by combining different motors. The 't' values and the significance of this statistic, which are reported for each regression model, gives an indication of the "statistical significance" of the slope of the aging trend in the Y-axis. Data and regression trend lines were plotted utilizing an IBM-4341 computer.

A motor-to-motor regression comparison was performed using the Analysis of Covariance (Table 2). The key LRSLA properties being tracked in the surveillance program were selected for this test. None of the 14 tests were significantly equal. The data from these motors should not be statistically combined since they have been biased differently at some point in time. Table 3 shows an abnormal difference visually displayed through the use of multi-symbol plotting of the three different motors. The comparisons indicate no homogenity of variance between motors. A decreasing regression trend line for motor 0012199 visually seems to be present.

ORIGIN SYMBOL TABLE

Origin	DOM	Wing	Symbol
0012099	63166	2	0
0012199	63227	2	1
STM-012	61221	1	S

TABLE 1
TEST PROGRAM

Test	Conditions	Config-uration	Nr Specimen	Total Specimens
Tensile , Low Rate	77°, 2 & 20 in/min	JANNAF Dogbone	5	40
Creep	77°, 10 & 12 lb Load	JANNAF Dogbone	3	24
Stress Relaxation	77°, 3 & 5% Strain	1/2"x1/2"x4"	3	24
Hardness	77°, Init & 10 sec	Dogbone Ends	5	40
HOE	77°	1/2"x3/8"x1"	5	40
DTA	77° Start	0.040" Wafers	3	12
Sol Gel	77°	1/2"x1/2"x1/2"	6	24
High Rate Tensile	77°, 1000 in/in/min	3/4" GL Dogbone	5	15
Triaxial High Rate	77°, 1000 in/in/min	3/4" GL Rail	3	9
Dynamic Response	77°, 70 gm ct.wt.	3.3"x.33"x.690" disc	3	9
Biaxial Constant Strain	77°	3/4" GL Rail	3	9
Motors STM-012 and 0012199 only will be for the following tests:				
Case Bond Tensile	77°, 0.2 in/min	1"x5/8"x3/4"	10	20
Tear Energy	77°F ± 2°	0.1"x1.18"x3"	8	16
Poisson's Ratio (Strain Dilatation) 10, 15, 20, 25, 30%	77°F ± 2°	0.50"x0.50"x4"	6	30

TEST RESULTS

Regression analysis is the method of evaluation used in the analysis of the test results. Regressions with the three motors combined (STM-012, 0012099 and 0012199) are presented as in previous reports. In addition, regressions for the separate motors are also presented in this report and previous report 470(82) for the testing that is also in the LRSLA program.

A. TENSILE:

1. Low Rate Tensile (2.0 in/min):

The strain at maximum stress regression (figure 1) for the combined group of all three motors shows a non-significant trend line slope. The regression trend lines for the individual motors, 0012099 (figure 1A) and STM-012 (figure 1C) show non-significant slopes. However, the individual trend line slope for motor 0012199 (figure 1B) shows a significantly decreasing trend line slope.

The strain at rupture regression (figure 3) for the combined group of all three motors shows a non-significant trend. The regression trend line for motor 0012099 (figure 3A) also shows a non-significant slope. However, the individual trend line slopes for motors 0012199 (figure 3B) and STM-012 (figure 3C) show a statistically significant negative trend.

Maximum stress (figure 2), stress at rupture (figure 4), and modulus (figure 5) for the combined group of all three motors show a non-significant trend line slope.

2. Low Rate Tensile (20.0 in/min):

The strain at maximum stress regression (figure 6) for the composite of all three motors shows a significant negative trend line slope. The regressions for the individual motors 0012099 (figure 6A) and 0012199 (figure 6B) show negative trends. The individual trend line for motor

STM-012 (figure 6C) is not significant.

The maximum stress (figure 7) for the composite group is not significant. Maximum stress for motors 0012099, 0012199 and STM-012 all show a statistically significant increase (figures 7A, 7B and 7C). Strain at rupture (figure 8) for the composite group shows a significant decreasing trend. Motors 0012099 (figure 8A) and 0012199 (figure 8B) also indicate a trend in the negative direction. However, motor STM-012 (figure 8C) has a non-significant slope. Stress at rupture (figure 9) and modulus (figure 10) composite trend lines show a statistically significant decreasing and increasing trend respectively.

3. High Rate Tensile (1000 in/min CHS):

No significant slope direction is shown for the high rate composite regressions (figures 11 thru 15).

4. High Rate Triaxial Tensile (1000 in/min, CHS 600 psi):

The composite regressions for strain at maximum stress (figure 16), strain at rupture (figure 18) and stress at rupture (figure 19) show a statistically significant increase. The composite regression for maximum stress (figure 17) has a non-significant trend line. Modulus (figure 20) shows a trend line with a decreasing slope in the negative direction.

5. Case Bond Tensile:

The composite regression for motors 0012199 and STM-012 (figure 21) and the individual regression for motor STM-012 (figure 21B) show negative trend line slopes. The regression trend line of individual motor 0012199 (figure 21A) shows no significance.

For motor 0012199, five specimens failed 100% in the adhesive liner to propellant with one specimen failing 100% in the adhesive liner to case.

For motor STM-012, the failure mode for all specimens was 100% adhesive liner to propellant.

B. CREEP:

The composite regressions for the 10 and 12 pound load test show a statistically significant decreasing trend line slope (figures 22 thru 29).

C. STRESS RELAXATION:

The stress relaxation modulus composite regressions at 3% strain show a statistically significant positive trend at 10, 50 and 100 seconds with no significant trend direction at 1000 seconds (figures 30 thru 33). The 5% strain composite regressions at 10 and 50 seconds show a significant positive trend with no significant trend at 100 and 1000 seconds (figures 34 thru 37).

D. CONSTANT STRAIN:

The composite regression (figure 38) and the individual motor STM-012 (figure 38B) show a negative directed regression trend. The individual regression trend line for motor 0012199 (figure 38A) is not significant.

E. HARDNESS (Shore A):

The 10 second composite regression (figure 39) and individual motor STM-012 regression (figure 39C) have negative trend lines. Individual motors 0012099 (figure 39A) and 0012199 (figure 39B) are not significant.

F. DYNAMIC RESPONSE:

The composite regressions for loss tangent at 200 HZ (figure 40) and 400 HZ (figure 41) are not significant. The storage shear modulus composite regressions for 200 HZ (figure 42) and 400 HZ (figure 43) have significant decreasing trends in the negative direction.

G. SOL GEL:

The composite regression trend lines for % extractables and weight swell ratio have significant positive trends while density and crosslink density have negative trend line slopes (figures 44 thru 47).

H. BURNING RATE:

The 500 psi composite regression (figure 48) and the individual motor 0012099 regression (figure 48A) show a non-significant trend. The individual motor 0012199 (figure 48B) has a positive trend while motor STM-012 shows no change (figure 48C).

At 1000 psi, the composite regression (figure 49) and the individual motor 0012099 (figure 49A) have significant negative slope direction. The individual motor regression for motor 0012199 (figure 49B) is not significant. The individual regression for STM-012 (figure 49C) shows a significant negative trend line.

I. HEAT OF EXPLOSION:

The composite regression (figure 50) and individual regression for motor STM-012 (figure 50C) show significantly positive trend lines. The regressions for the individual motors 0012099 (figure 50A) and 0012199 (figure 50B) are not significant.

J. DIFFERENTIAL THERMAL ANALYSIS (DTA):

The endotherm composite regression (figure 51) and the individual regressions for motor 0012099 (figure 51A) and 0012199 (figure 51B) have significantly decreasing trend lines. Motor STM-012 is not significant (figure 51C).

The exotherm composite regression (figure 52) and individual motor 0012199 (figure 52B) are not significant. The individual motors 0012099

(figure 52A) and STM-012 (figure 52C) have significantly negative trends.

The ignition temperature composite regression (figure 53) and individual motor 0012199 (figure 53B) regression have non-significant trend lines. Individual motors 0012099 (figure 53A) and STM-012 (figure 53C) regressions have statistically significant positive trend line slopes.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

A. TENSILE SUMMARY:

1. Combined Group Motors: Where significant changes are indicated, the changes are gradual and no problems are foreseen. The regression trends are not consistent when comparing the respective strains and stresses obtained under different conditions as seen in First Stage block testing. The most probable reason for this inconsistency is the variance between motors as shown in Table 2.

2. Individual Motors: For those regressions where significant trends are seen, the changes are gradual and no problems are indicated. These regressions show the same general trends as seen in the block propellant testing. The individual motor regressions show the propellant with less strain capability and higher tensile strength as the age increases.

B. THERMAL AND COMBUSTION SUMMARY:

From the analyses, the thermal properties are not undergoing a drastic change, with respect to age, at this time.

C. CONCLUSIONS:

The test results for both combined and individual motor regressions show that, under present storage conditions, some of the physical and combustion properties of the propellant indicate statistically significant aging trends. However, where a significant trend is indicated, the slope of the trend line is gradual and no operational problems are expected.

Although some aging trends have been observed, it does not appear that significant degradation will occur in the propellant within the next two years.

D. RECOMMENDATIONS:

It is recommended that motors be reported separately at the next test phase.

TABLE 2

ANALYSIS OF COVARIANCE SUMMARY
Comparison of Regressions Between 0012099, 0012199 & STM-012

Test	Residual Mean Squares 0012099	0012199	STM-012	Difference Between Residual Trend Lines Variance	Slope	Elevation
Tensile:						
Strain at Max Stress, 77°F, 2.0 in/min	.00029	.00023	.00016	S		
Strain at Rupture, 2.0 in/min, 77°F	.00046	.00045	.00042	NS	S	
Strain at Max Stress, 77°F, 20.0 in/min	.00027	.00046	.00070	S		
Strain at Rupture, 77°F, 20.0 in/min	.00047	.00100	.00048	S		
Case Bond, 77°F, 0.2 in/min		565	174	S		
Constant Strain, 77°F Strain at Rupture		4.81	7.30	NS	S	
Hardness, Shore A, 77°F, 10 sec	6.80	5.54	6.28	NS	NS	S
Burn Rate						
500 psi Initial Pressure	.00016	.00071	.00069	S		
1000 psi Initial Pressure	.00018	.00040	.00014	S		
Ignitability, Ignition Threshold Point 168	53.2	5.69	28.8	S		
Heat of Explosion	72.7	133.1	285.7	S		
DTA						
Endotherm 1	5.25	1.84	5.03	S		
Exotherm 1	4.14	4.49	14.16	S		
Ignition Temperature	169.5	114.4	38.5	S		

S = Data are significantly different
NS = Data not significant

NOTE: Analysis performed at the 5% significant level

TABLE 3

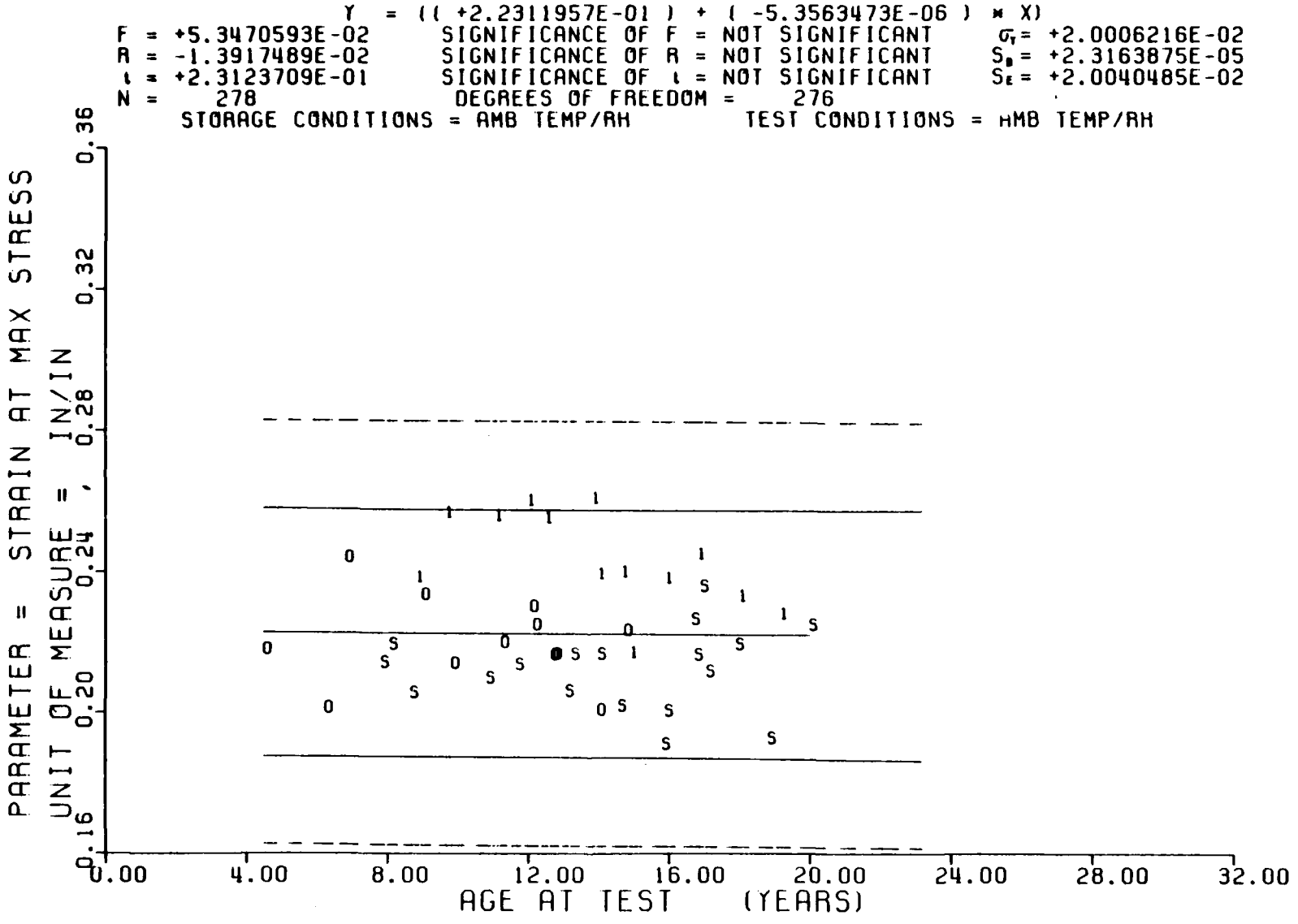
REGRESSION TREND LINE SUMMARY

Test	Composite Three Motors	Individual Motors 0012099	0012199	STM-012
Low Rate Tensile, 77°F, 2.0 in/min				
Strain at Max Stress	NS	NS	-	NS
Maximum Stress	NS			
Strain at Rupture	NS	NS	-	-
Stress at Rupture	NS			
Modulus	NS			
Low Rate Tensile, 77°F, 20.0 in/min				
Strain at Max Stress	-	-	-	NS
Maximum Stress	NS	+	+	+
Strain at Rupture	-	-	-	NS
Stress at Rupture	NS			
Modulus	+			
High Rate Tensile, 77°F, 1750 in/in/min				
Strain at Max Stress	NS			
Maximum Stress	NS			
Strain at Rupture	-			
Stress at Rupture	NS			
Modulus	NS			
High Rate Triaxial Tensile, 1750 CHS, 600 psi, 77°F				
Strain at Max Stress	+			
Maximum Stress	NS			
Strain at Rupture	+			
Stress at Rupture	+			
Modulus	-			
Case Bond Tensile, 77°F	-		NS	-
Creep, 10 lb Load, 10 sec	-			
20 sec	-			
1000 sec	-			
10,000 sec	-			
Creep, 12 lb Load, 10 sec	-			
20 sec	-			
1000 sec	-			
10,000 sec	-			
Stress Relaxation, 3% Strain, 10 sec	+			
50 sec	+			
100 sec	+			
1000 sec	NS			
Stress Relaxation, 5% Strain, 10 sec	+			
50 sec	+			
100 sec	NS			
1000 sec	NS			

TABLE 3 (cont)

Test	Composite Three Motors	Individual Motors 0012099	0012199	STM-012
Constant Strain, 77°F	-		NS	-
Hardness, Shore A, 77°F, 10 sec	-	NS	NS	-
Dynamic Response				
Loss Tangent, 200 HZ	NS			
Loss Tangent, 400 HZ	NS			
Storage Shear Modulus, 200 HZ	-			
Storage Shear Modulus, 400 HZ	-			
Sol Gel				
% Extractables	+			
Weight Swell Ratio	+			
Density	-			
Crosslink Density	-			
Burning Rate				
500 psi	NS	NS	+	NS
1000 psi	-	-	NS	-
Heat of Explosion	+	NS	NS	+
DTA				
Endotherm 1	-	-	-	NS
Exotherm 1	NS	-	NS	-
Ignition Temperature	NS	+	NS	+

NS = Non-significant trend from a line of zero slope.
+ = Significant slope in a positive direction.
- = Significant slope in a negative direction.



STAGE 1 DISSECTED MOTORS,LOW RATE CHS=2.0 IN/MIN,STRAIN MAX STRESS

Figure 1

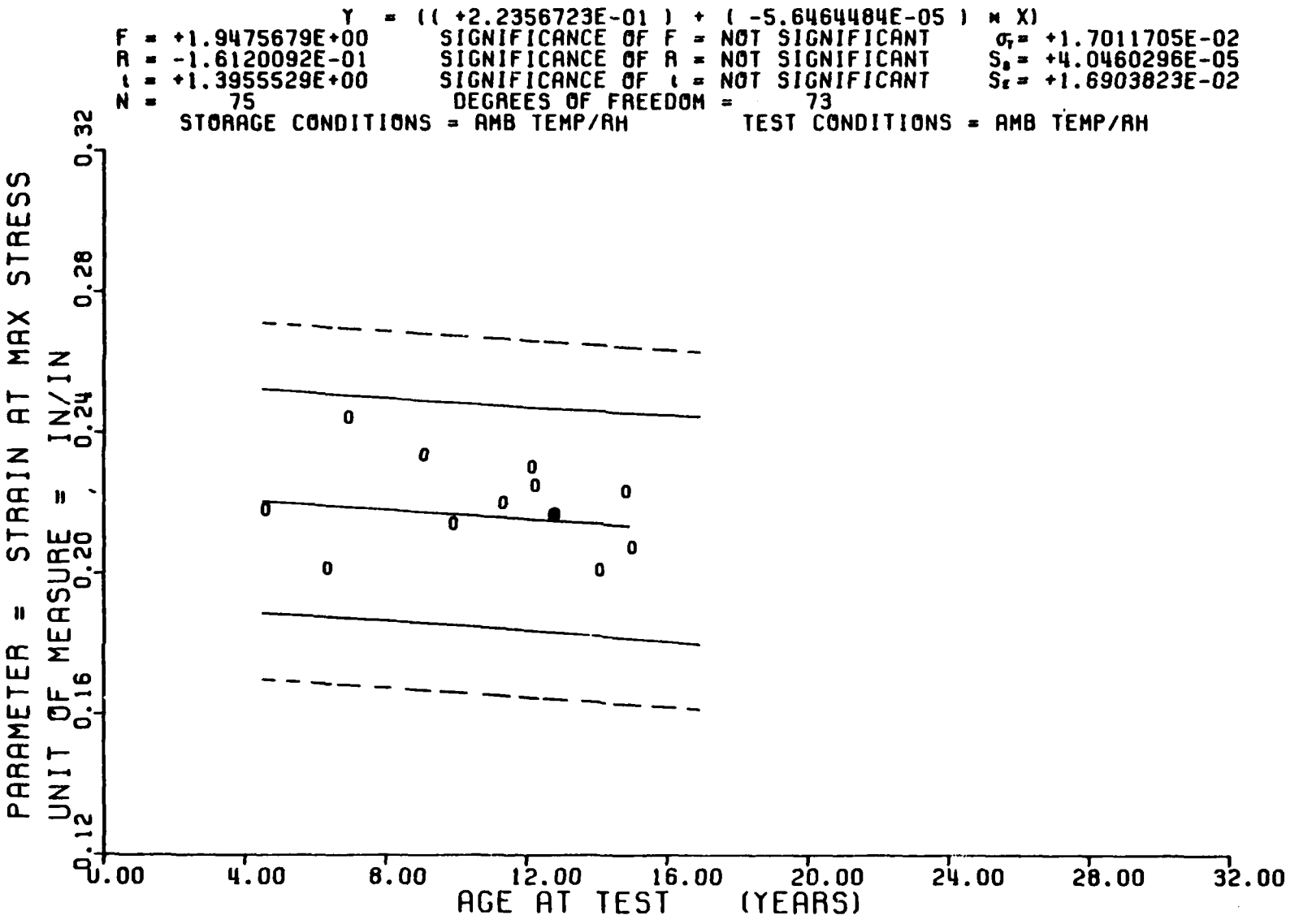
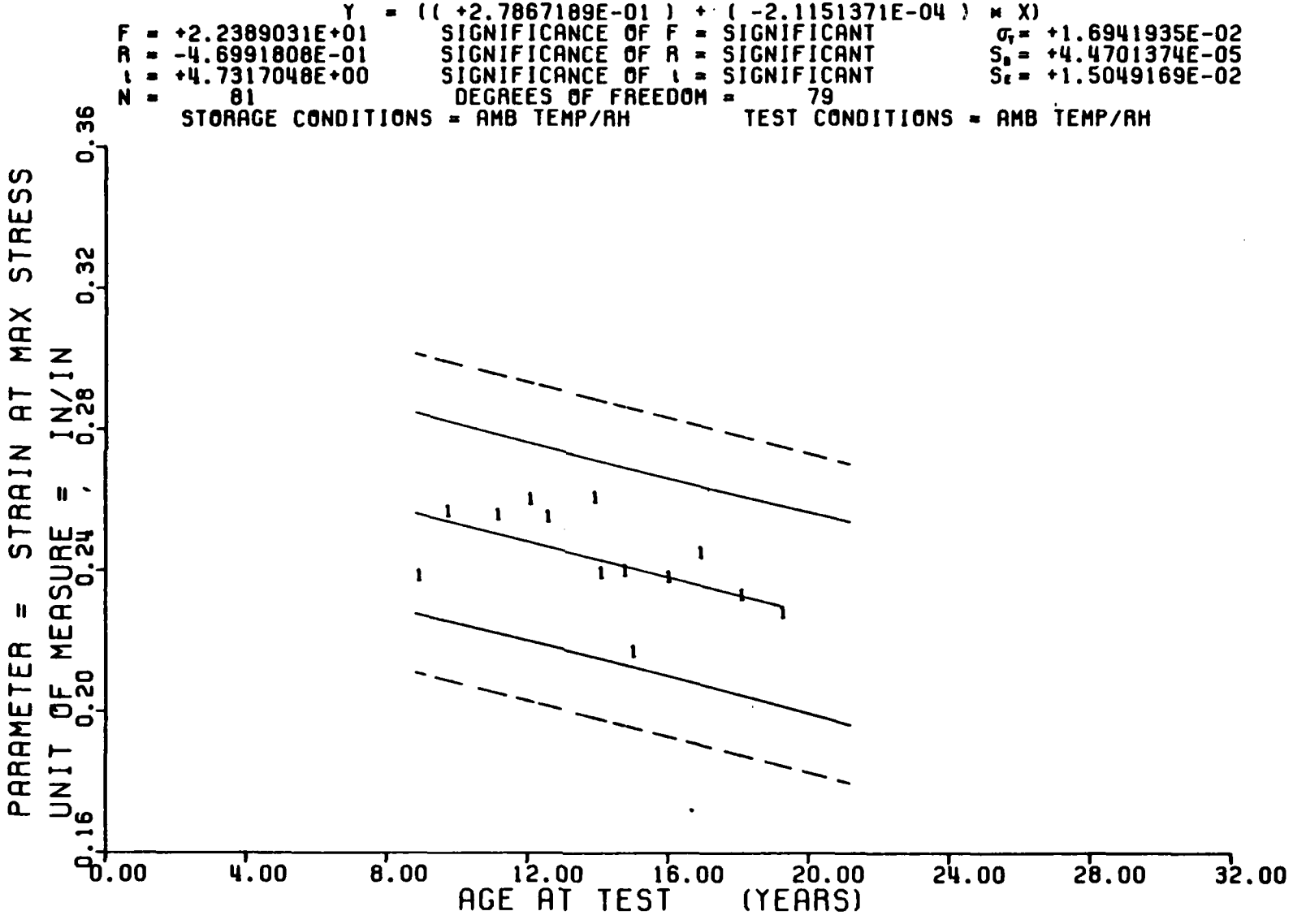

Y = ((+2.2356723E-01) + (-5.6464484E-05) * X)
F = +1.9475679E+00 SIGNIFICANCE OF F = NOT SIGNIFICANT σr = +1.7011705E-02
R = -1.6120092E-01 SIGNIFICANCE OF R = NOT SIGNIFICANT Sa = +4.0460296E-05
t = +1.3955529E+00 SIGNIFICANCE OF t = NOT SIGNIFICANT Sε = +1.6903823E-02
N = 75 DEGREES OF FREEDOM = 73
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT MAX STRESS
UNIT OF MEASURE = IN/IN
0.12
0.16
0.20
0.24
0.28
0.32
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1 DISSECTED MOTOR=0012099,LOW RATE CHS=2.0 IN/MIN,STRAIN MAX STRESS

Figure 1A



STAGE 1 DISSECTED MOTOR=0012199,LOW RATE CHS=2.0 IN/MIN,STRAIN MAX STRESS

Figure 1B

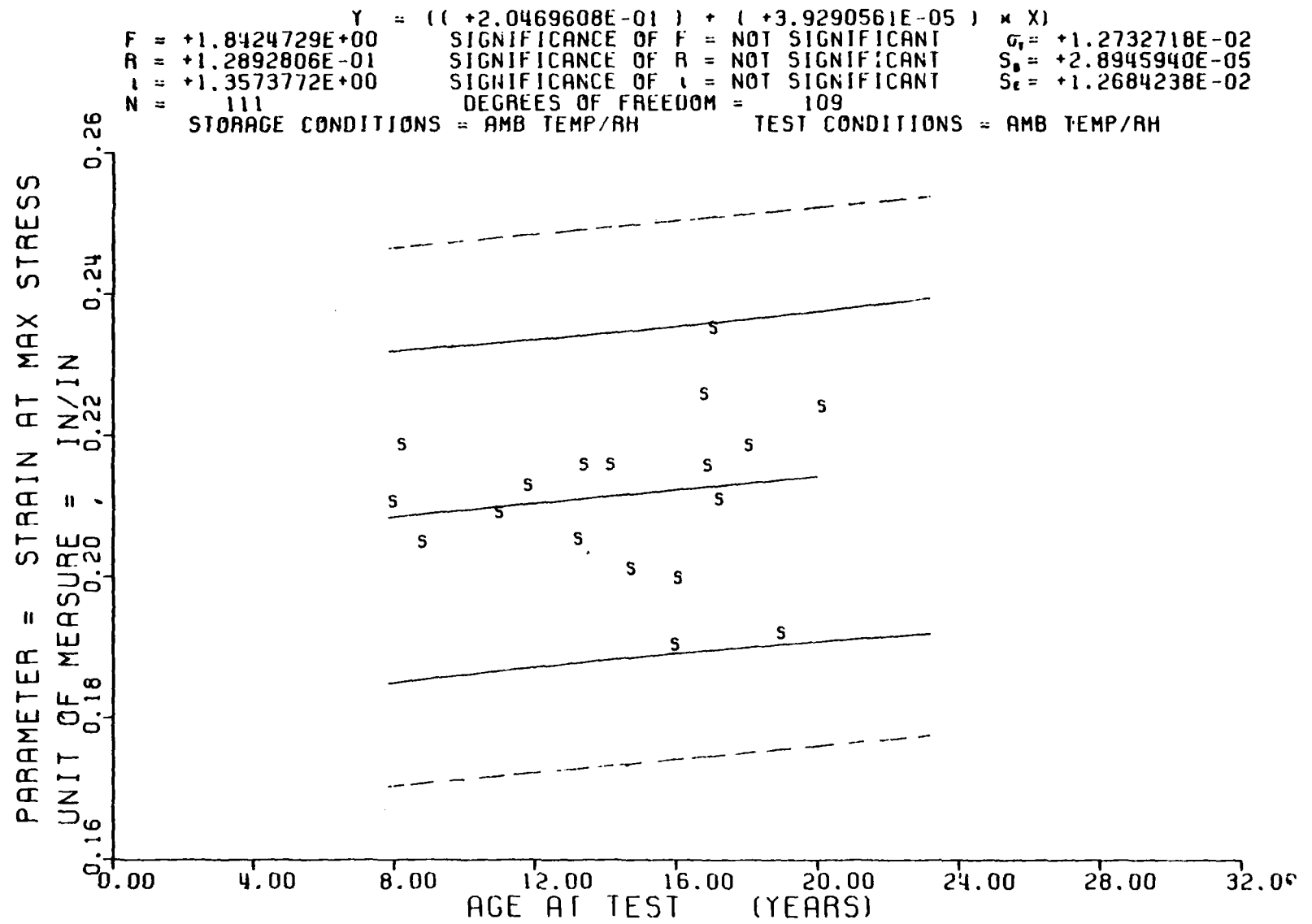
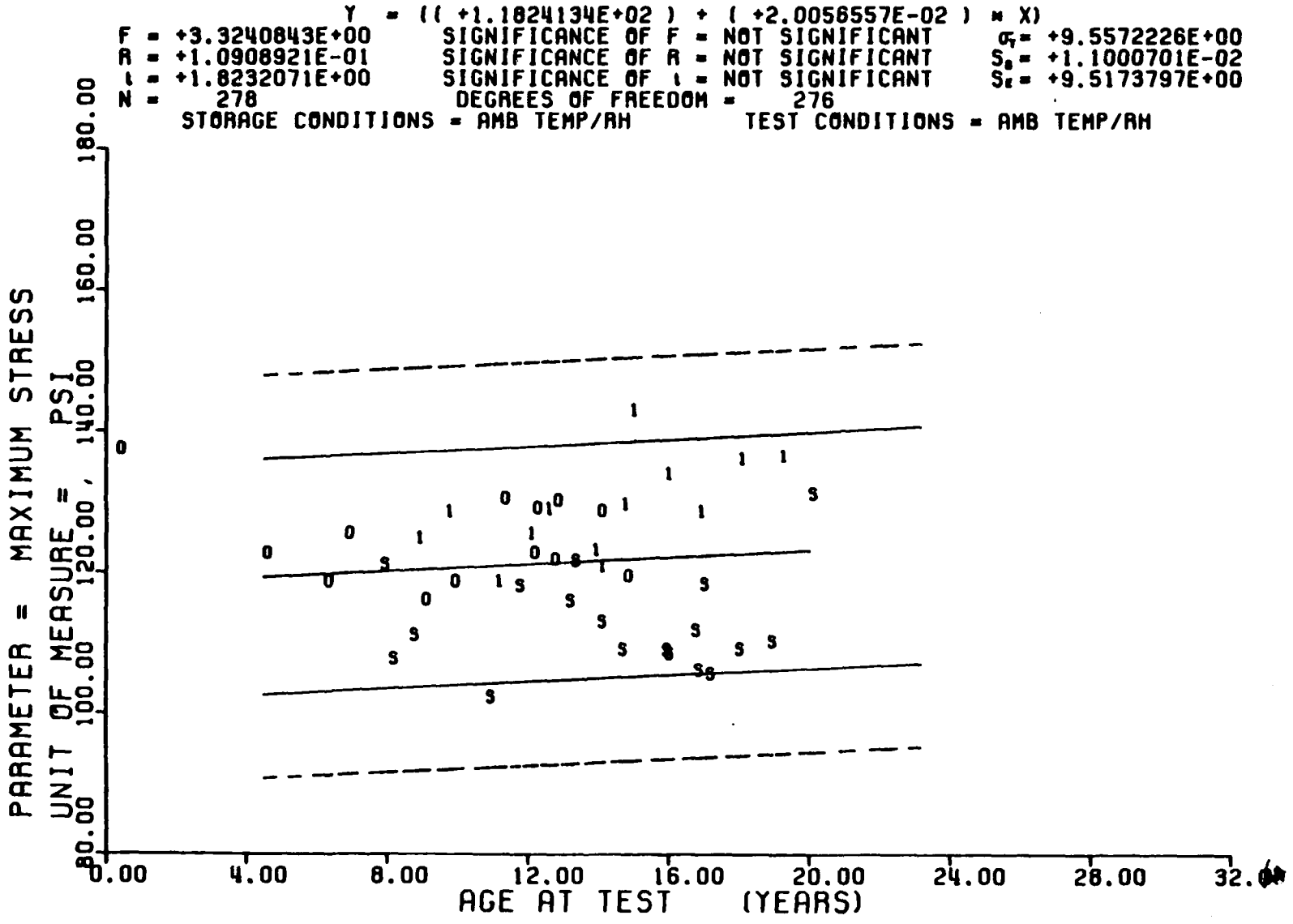
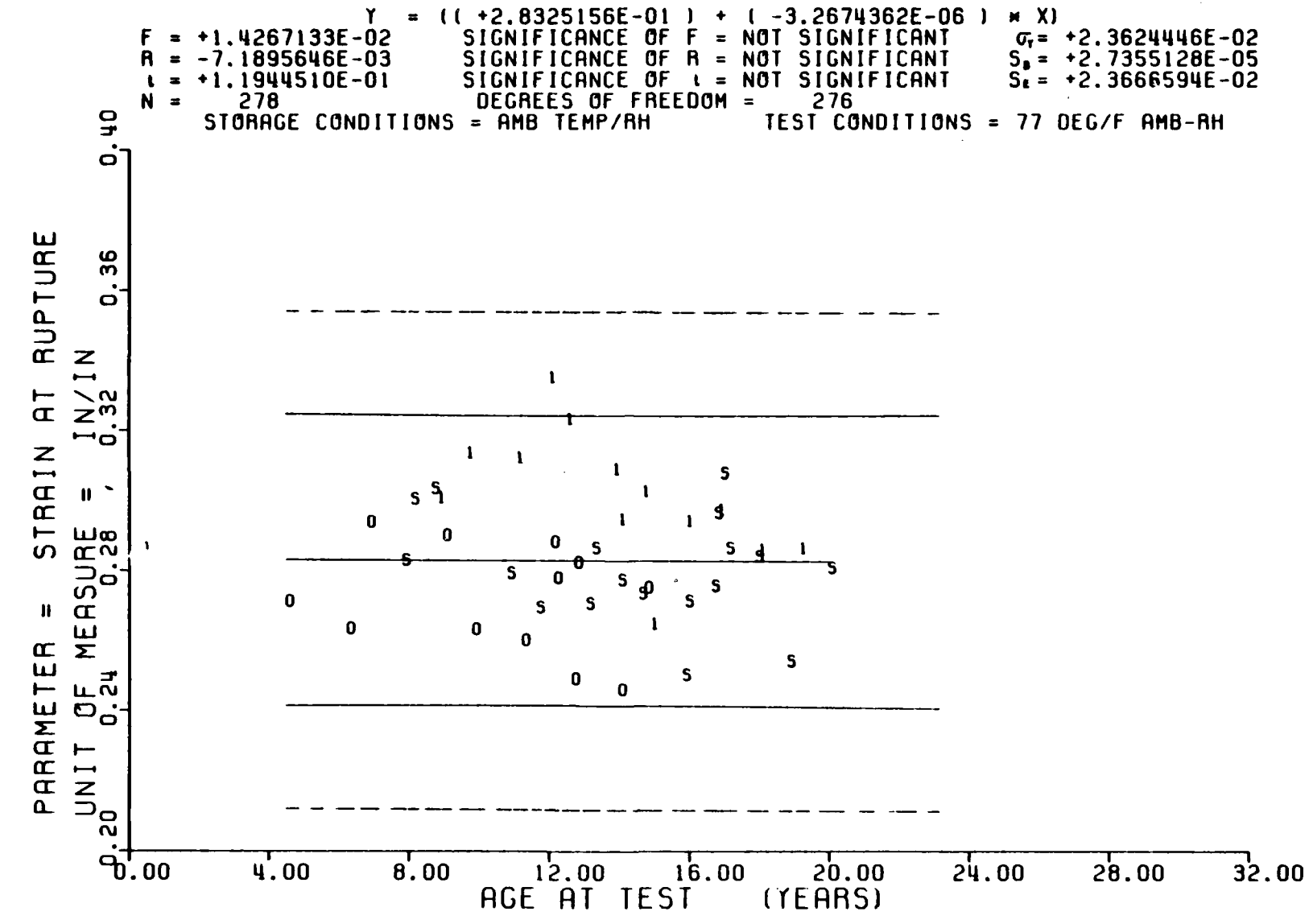

Y = ((+2.0469608E-01) + (+3.9290561E-05) * X)
F = +1.8424729E+00 SIGNIFICANCE OF F = NOT SIGNIFICANT σ = +1.2732718E-02
R = +1.2892806E-01 SIGNIFICANCE OF R = NOT SIGNIFICANT S = +2.8945940E-05
t = +1.3573772E+00 SIGNIFICANCE OF t = NOT SIGNIFICANT S = +1.2684238E-02
N = 111 DEGREES OF FREEDOM = 109
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT MAX STRESS
UNIT OF MEASURE = IN/IN
0.16
0.18
0.20
0.22
0.24
0.26
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
AGE AT TEST (YEARS)
STAGE 1 DISSECTED MOTOR=STM-012,LOW RATE CHS=2.0 IN/MIN,STRAIN MAX STRESS

Figure 1C



STAGE 1 DISSECTED MOTORS,LOW RATE CHS=2.0 IN/MIN,MAXIMUM STRESS

Figure 2



STAGE 1 DISSECTED MOTORS,LOW RATE CHS=2.0 IN/MIN,STRAIN AT RUPTURE

Figure 3

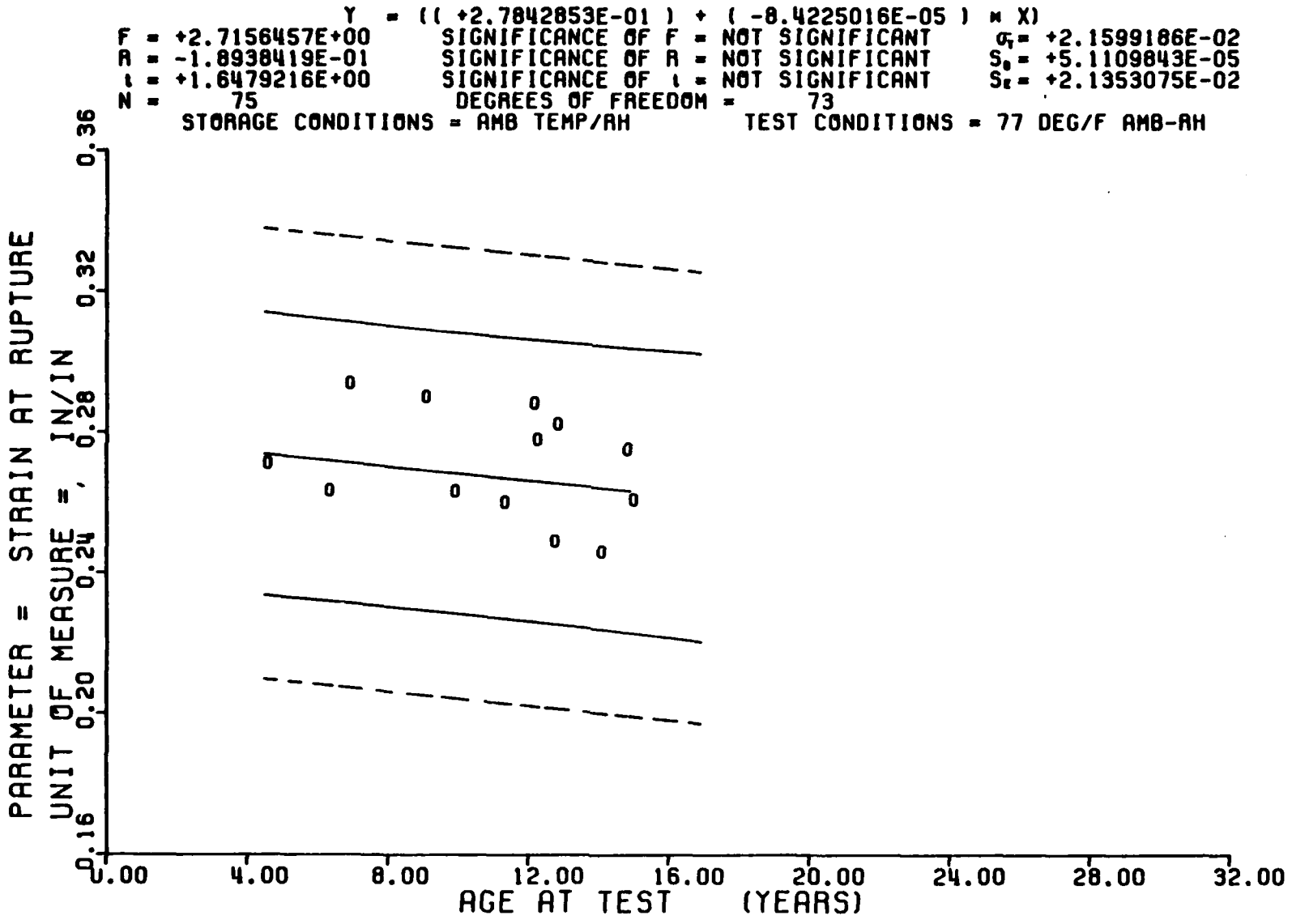

Y = ((+2.7842853E-01) + (-8.4225016E-05) * X)
F = +2.7156457E+00 SIGNIFICANCE OF F = NOT SIGNIFICANT σt = +2.1599186E-02
R = -1.8938419E-01 SIGNIFICANCE OF R = NOT SIGNIFICANT Sb = +5.1109843E-05
t = +1.6479216E+00 SIGNIFICANCE OF t = NOT SIGNIFICANT Sr = +2.1353075E-02
N = 75 DEGREES OF FREEDOM = 73
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = 77 DEG/F AMB-RH
PARAMETER = STRAIN AT RUPTURE
UNIT OF MEASURE = IN/IN
0.36
0.32
0.28
0.24
0.20
0.16
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1 DISSECTED MOTOR=0012099,LOW RATE CHS=2.0 IN/MIN,STRAIN AT RUPTURE

Figure 3A

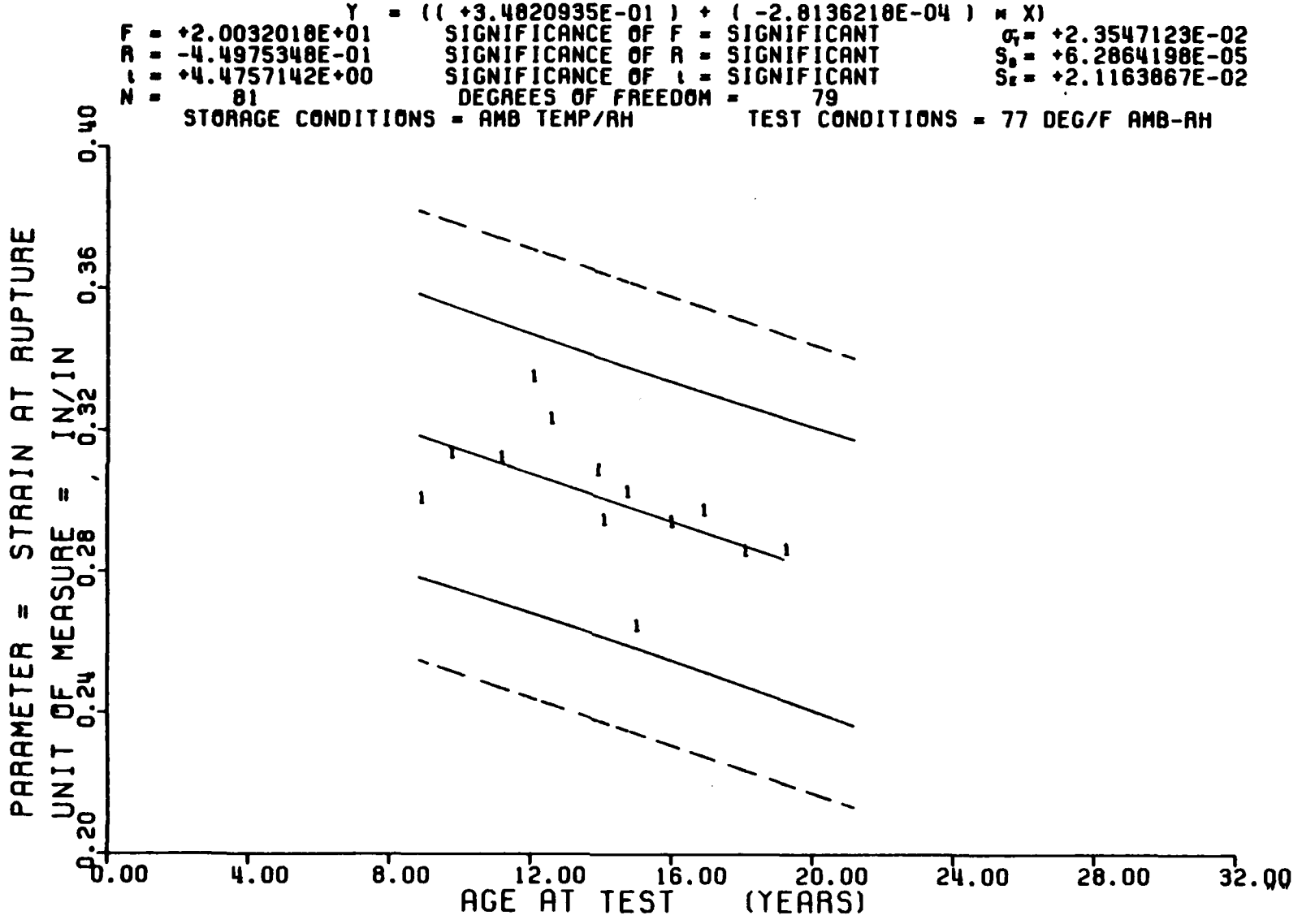

Y = ((+3.4820935E-01) + (-2.8136210E-04) * X)
F = +2.0032018E+01 SIGNIFICANCE OF F = SIGNIFICANT σ1 = +2.3547123E-02
R = -4.4975348E-01 SIGNIFICANCE OF R = SIGNIFICANT Sb = +6.2864198E-05
t = +4.4757142E+00 SIGNIFICANCE OF t = SIGNIFICANT Se = +2.1163867E-02
N = 81 DEGREES OF FREEDOM = 79
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = 77 DEG/F AMB-RH
PARAMETER = STRAIN AT RUPTURE
UNIT OF MEASURE = IN/IN
0.40
0.36
0.32
0.28
0.24
0.20
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1 DISSECTED MOTOR=0012199,LOW RATE CHS=2.0 IN/MIN,STRAIN AT RUPTURE

Figure 3B

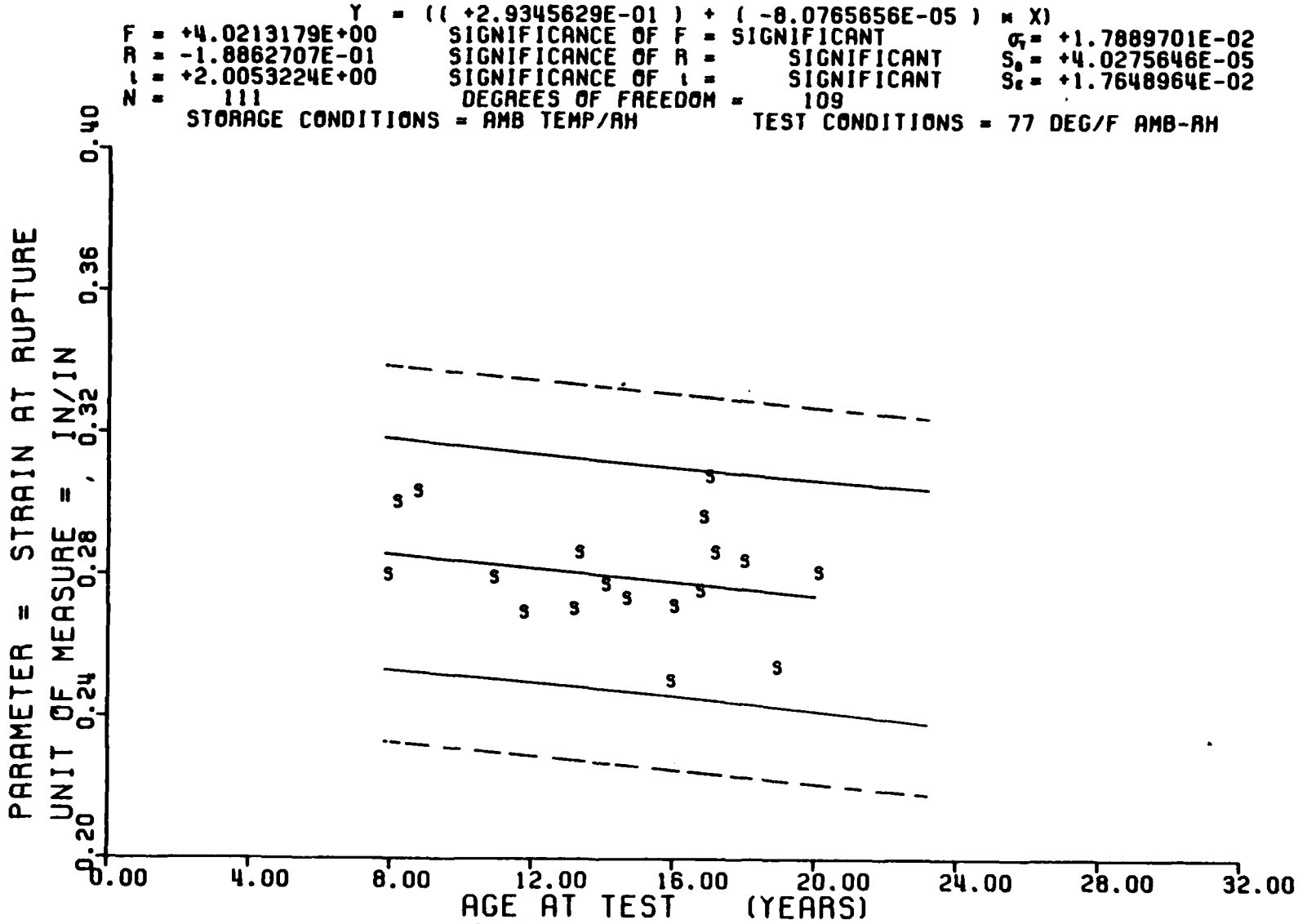
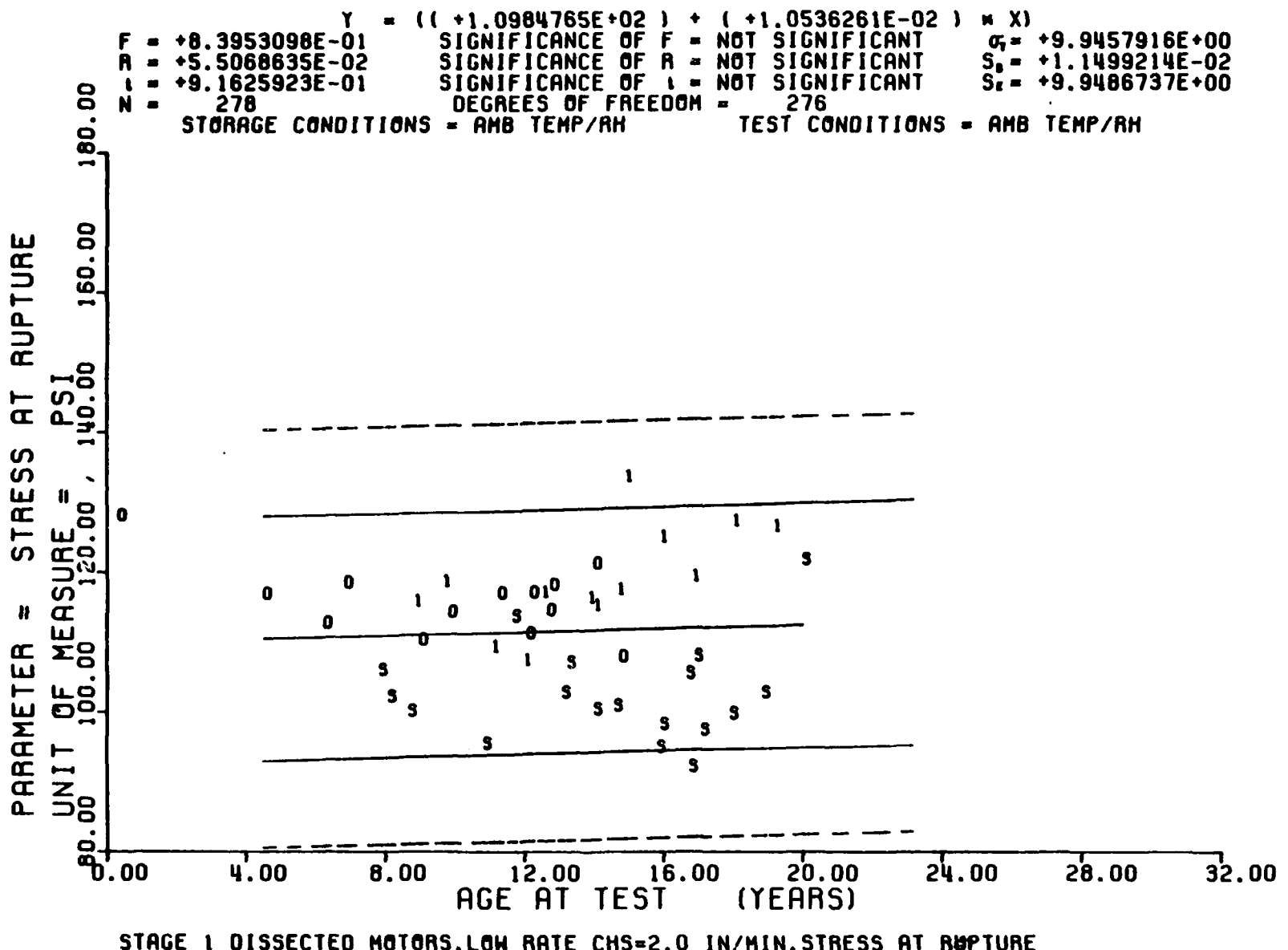
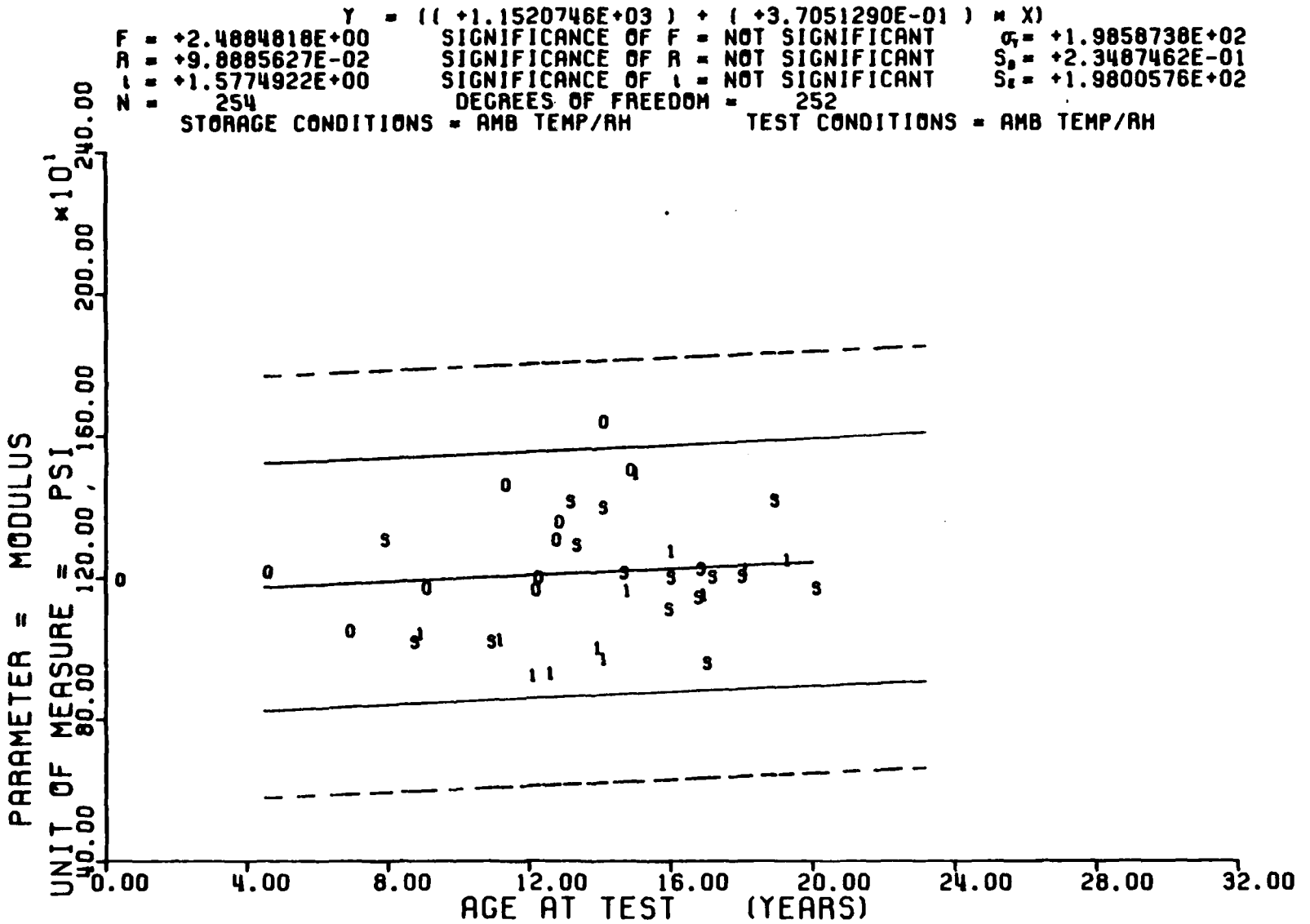

Y = ((+2.9345629E-01) + (-8.0765656E-05) * X)
F = +4.0213179E+00 SIGNIFICANCE OF F = SIGNIFICANT σ = +1.7889701E-02
R = -1.8862707E-01 SIGNIFICANCE OF R = SIGNIFICANT Sb = +4.0275646E-05
ι = +2.0053224E+00 SIGNIFICANCE OF ι = SIGNIFICANT Sε = +1.7648964E-02
N = 111 DEGREES OF FREEDOM = 109
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = 77 DEG/F AMB-RH
PARAMETER = STRAIN AT RUPTURE
UNIT OF MEASURE = IN/IN
0.40
0.36
0.32
0.28
0.24
0.20
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1 DISSECTED MOTOR=STM-012,LOW RATE CHS=2.0 IN/MIN,STRAIN AT RUPTURE

Figure 3C



STAGE 1 DISSECTED MOTORS,LOW RATE CHS=2.0 IN/MIN,STRESS AT RUPTURE

Figure 4



STAGE 1 DISSECTED MOTORS,LOW RATE CHS=2.0 IN/MIN,MODULUS

Figure 5

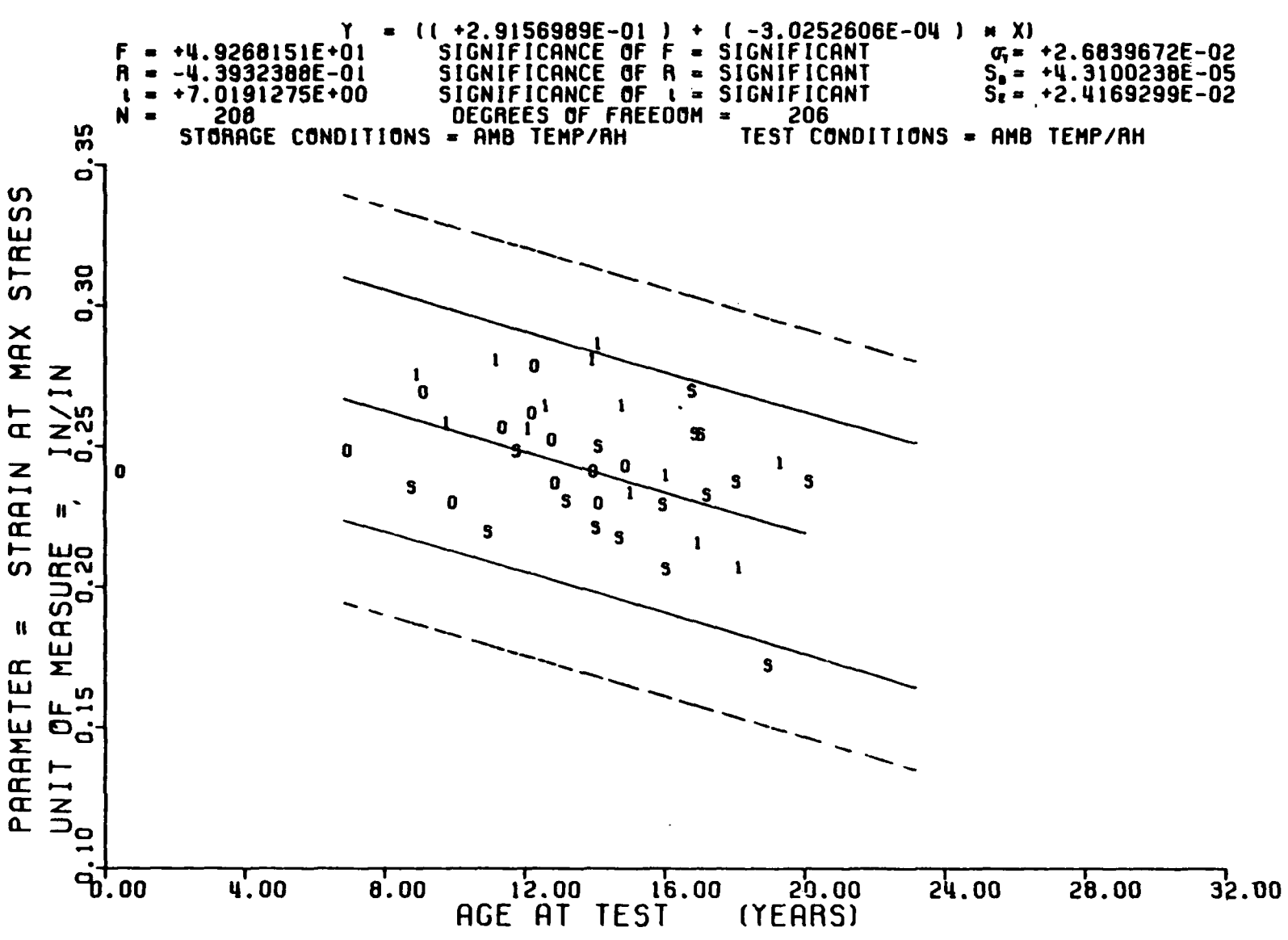

Y = ((+2.9156989E-01) + (-3.0252606E-04) * X)
F = +4.9268151E+01 SIGNIFICANCE OF F = SIGNIFICANT σr = +2.6839672E-02
R = -4.3932388E-01 SIGNIFICANCE OF R = SIGNIFICANT Sb = +4.3100238E-05
t = +7.0191275E+00 SIGNIFICANCE OF t = SIGNIFICANT Se = +2.4169299E-02
N = 208 DEGREES OF FREEDOM = 206
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT MAX STRESS
UNIT OF MEASURE = IN/IN
0.35
0.30
0.25
0.20
0.15
0.10
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1 DISSECTED MOTORS,LOW RATE CHS=20.0 IN/MIN,STRAIN MAX STRESS

Figure 6

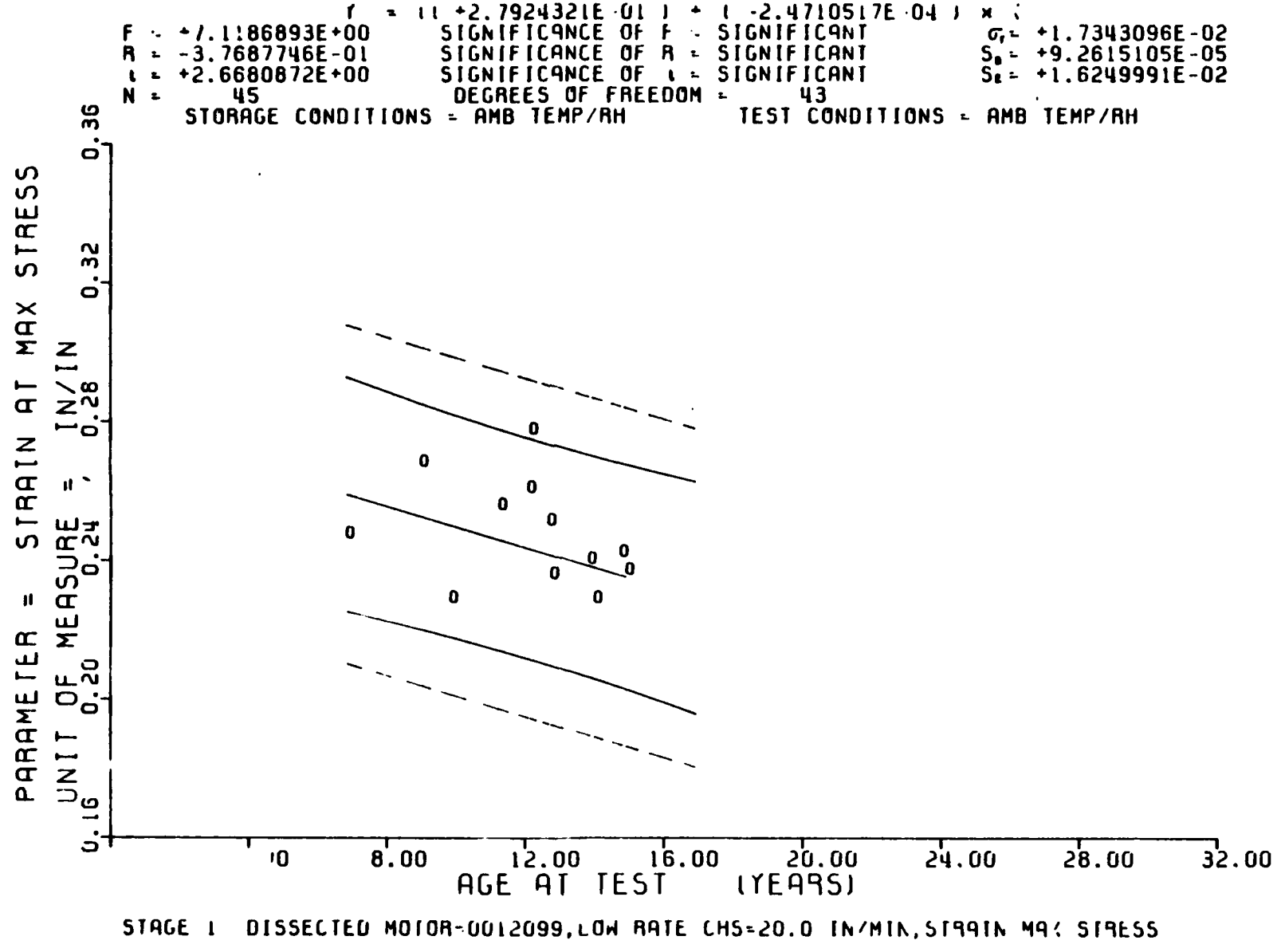

f = (+2.7924321E-01) + (-2.4710517E-04) x
F = +7.1186893E+00 SIGNIFICANCE OF F = SIGNIFICANT σf = +1.7343096E-02
R = -3.7687746E-01 SIGNIFICANCE OF R = SIGNIFICANT Sβ = +9.2615105E-05
t = +2.6680872E+00 SIGNIFICANCE OF t = SIGNIFICANT Sε = +1.6249991E-02
N = 45 DEGREES OF FREEDOM = 43
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT MAX STRESS
UNIT OF MEASURE = IN/IN
0.36
0.32
0.28
0.24
0.20
0.16
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1 DISSECTED MOTOR-0012099,LOW RATE CHS=20.0 IN/MIN,STRAIN AT STRESS

Figure 6A

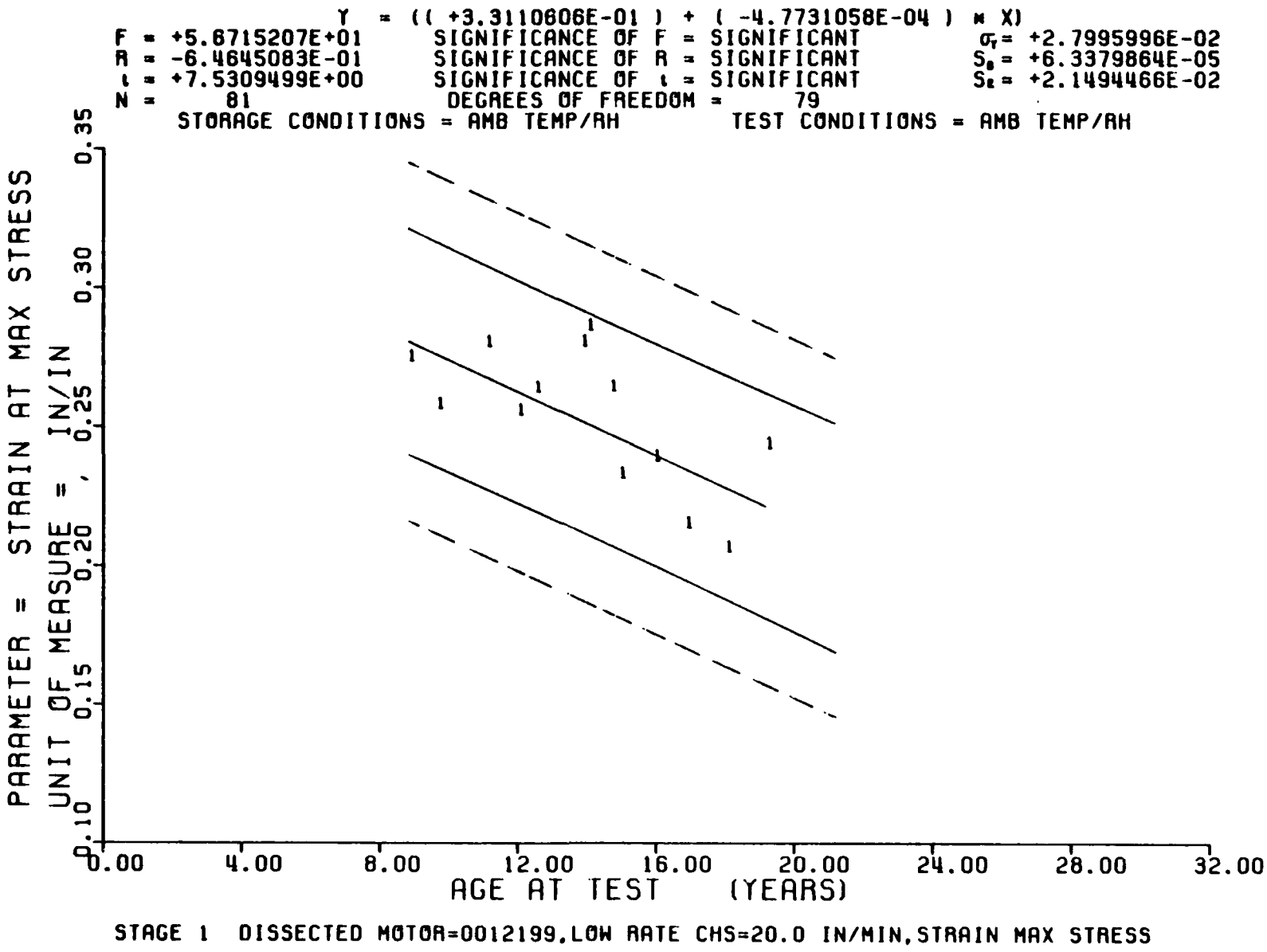

Y = ((+3.3110606E-01) + (-4.7731058E-04) * X)
F = +5.6715207E+01 SIGNIFICANCE OF F = SIGNIFICANT
R = -6.4645083E-01 SIGNIFICANCE OF R = SIGNIFICANT
t = +7.5309499E+00 SIGNIFICANCE OF t = SIGNIFICANT
N = 81 DEGREES OF FREEDOM = 79
STORAGE CONDITIONS = AMB TEMP/RH
TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT MAX STRESS
UNIT OF MEASURE = IN/IN
0.10
0.15
0.20
0.25
0.30
0.35
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1 DISSECTED MOTOR=0012199,LOW RATE CHS=20.0 IN/MIN,STRAIN MAX STRESS

Figure 6B

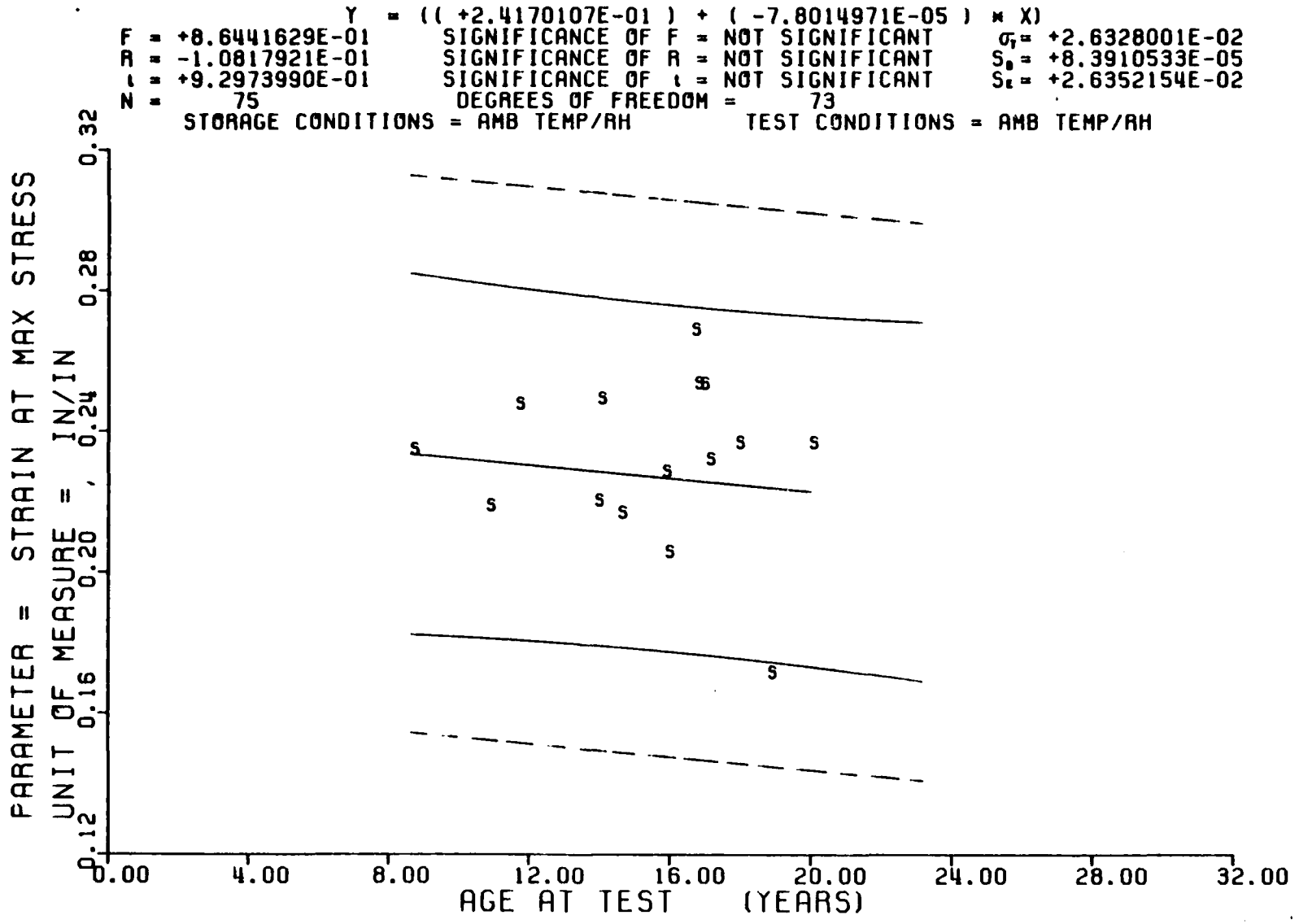
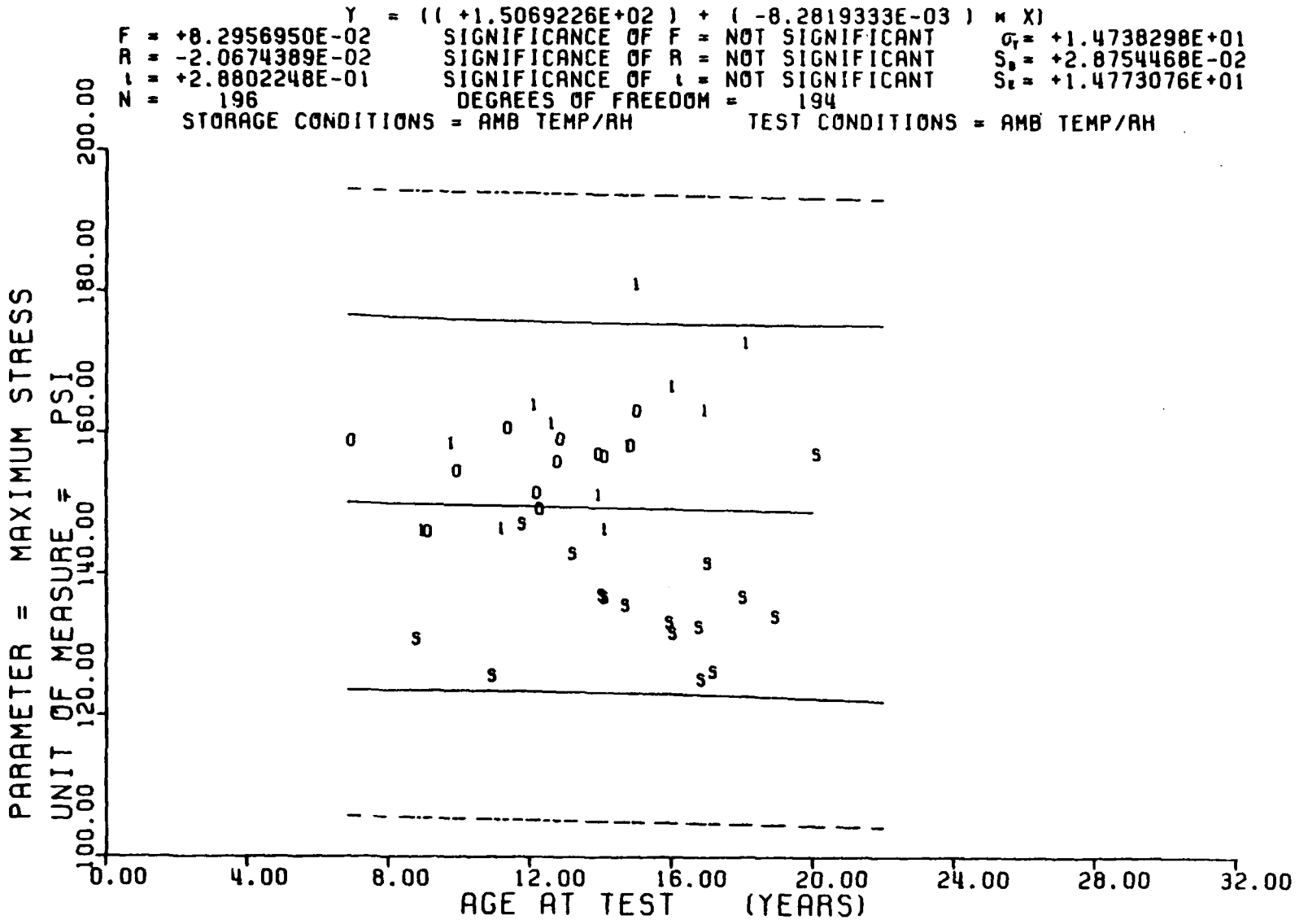

Y = ((+2.4170107E-01) + (-7.8014971E-05) * X)
F = +8.6441629E-01 SIGNIFICANCE OF F = NOT SIGNIFICANT σ1 = +2.6328001E-02
R = -1.0817921E-01 SIGNIFICANCE OF R = NOT SIGNIFICANT Sb = +8.3910533E-05
t = +9.2973990E-01 SIGNIFICANCE OF t = NOT SIGNIFICANT Sε = +2.6352154E-02
N = 75 DEGREES OF FREEDOM = 73
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT MAX STRESS
UNIT OF MEASURE = IN/IN
0.32
0.28
0.24
0.20
0.16
0.12
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1 DISSECTED MOTOR=STM-012,LOW RATE CHS=20.0 IN/MIN,STRAIN MAX STRESS

Figure 6C



STAGE 1 DISSECTED MOTORS,LOW RATE CHS=20.0 IN/MIN,MAXIMUM STRESS

Figure 7

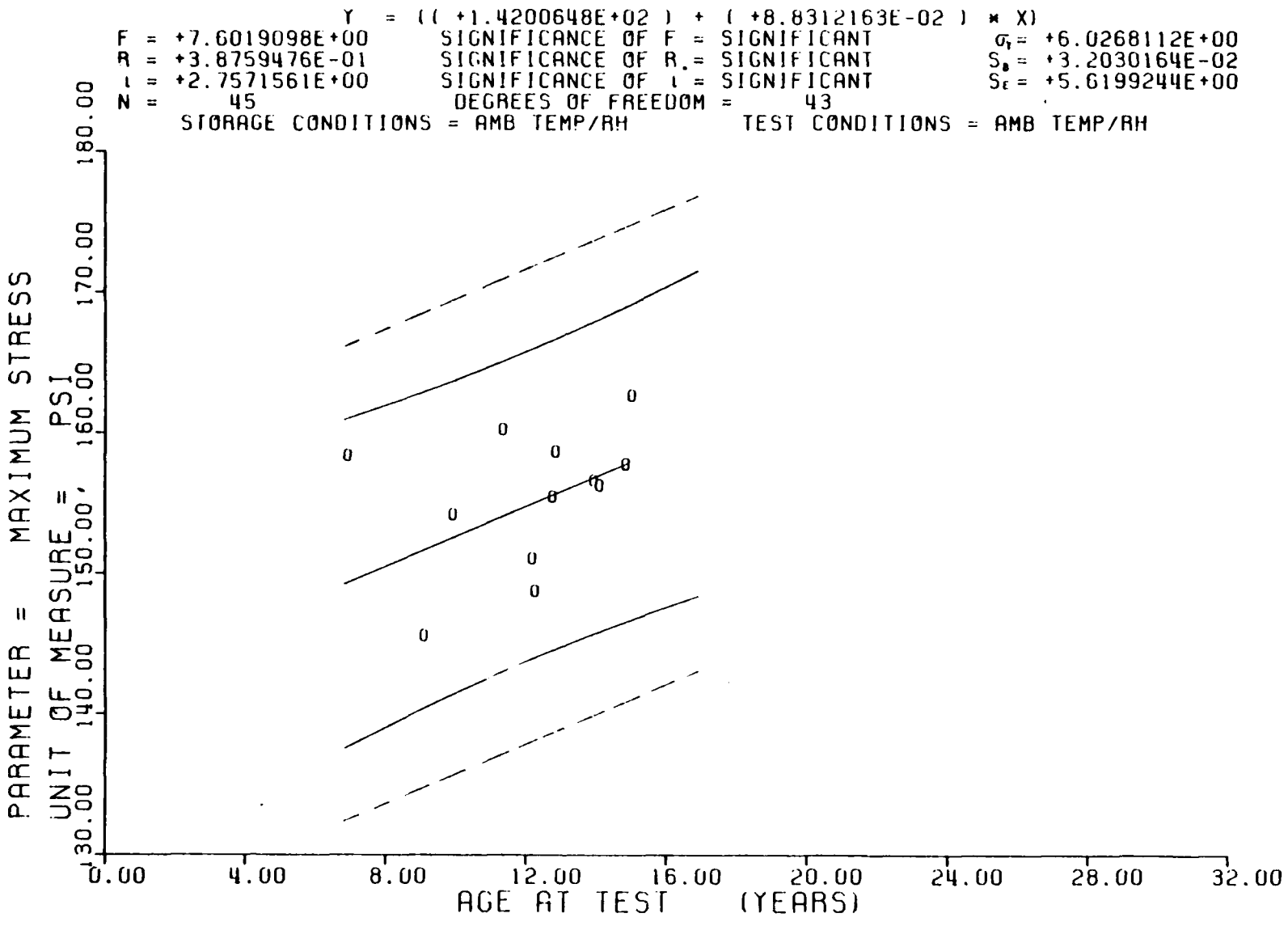

Y = ((+1.4200648E+02) + (+8.8312163E-02) * X)
F = +7.6019098E+00 SIGNIFICANCE OF F = SIGNIFICANT σ = +6.0268112E+00
R = +3.8759476E-01 SIGNIFICANCE OF R = SIGNIFICANT S = +3.2030164E-02
ι = +2.7571561E+00 SIGNIFICANCE OF ι = SIGNIFICANT S = +5.6199244E+00
N = 45 DEGREES OF FREEDOM = 43
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = MAXIMUM STRESS
UNIT OF MEASURE = PSI
130.00
140.00
150.00
160.00
170.00
180.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,DISSECTED MOTOR=0012099,LOW RATE CHS=20.0 IN/MIN,MAX STRESS.

Figure 7A

Y = ((+1.2515456E+02) + (+2.0927721E-01) * X)

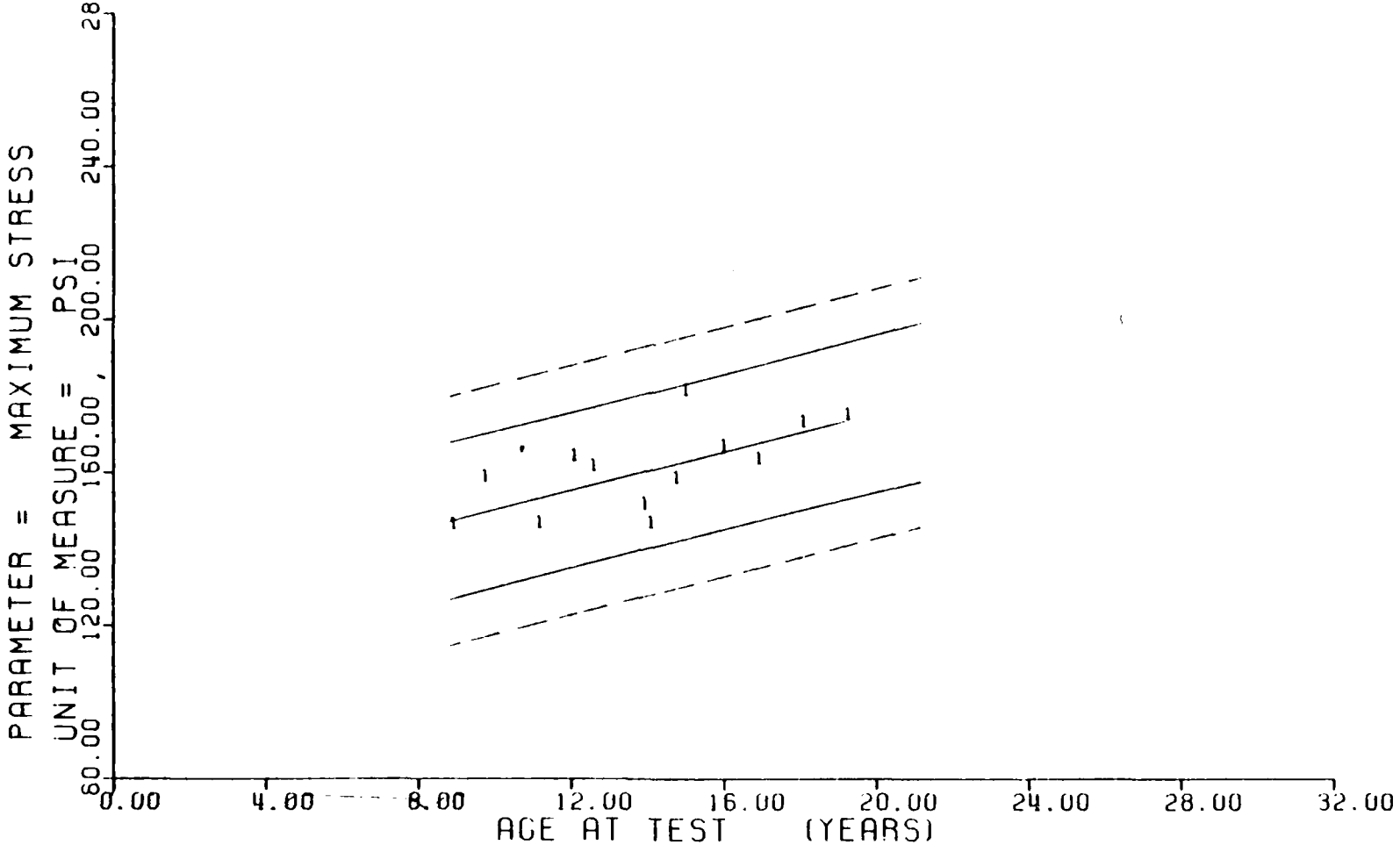
F = +4.2754528E+01 SIGNIFICANCE OF F = SIGNIFICANT σ_r = +1.3390716E+01

R = +5.9258206E-01 SIGNIFICANCE OF R = SIGNIFICANT S_b = +3.2005962E-02

I = +6.5386947E+00 SIGNIFICANCE OF I = SIGNIFICANT S_I = +1.0854410E+01

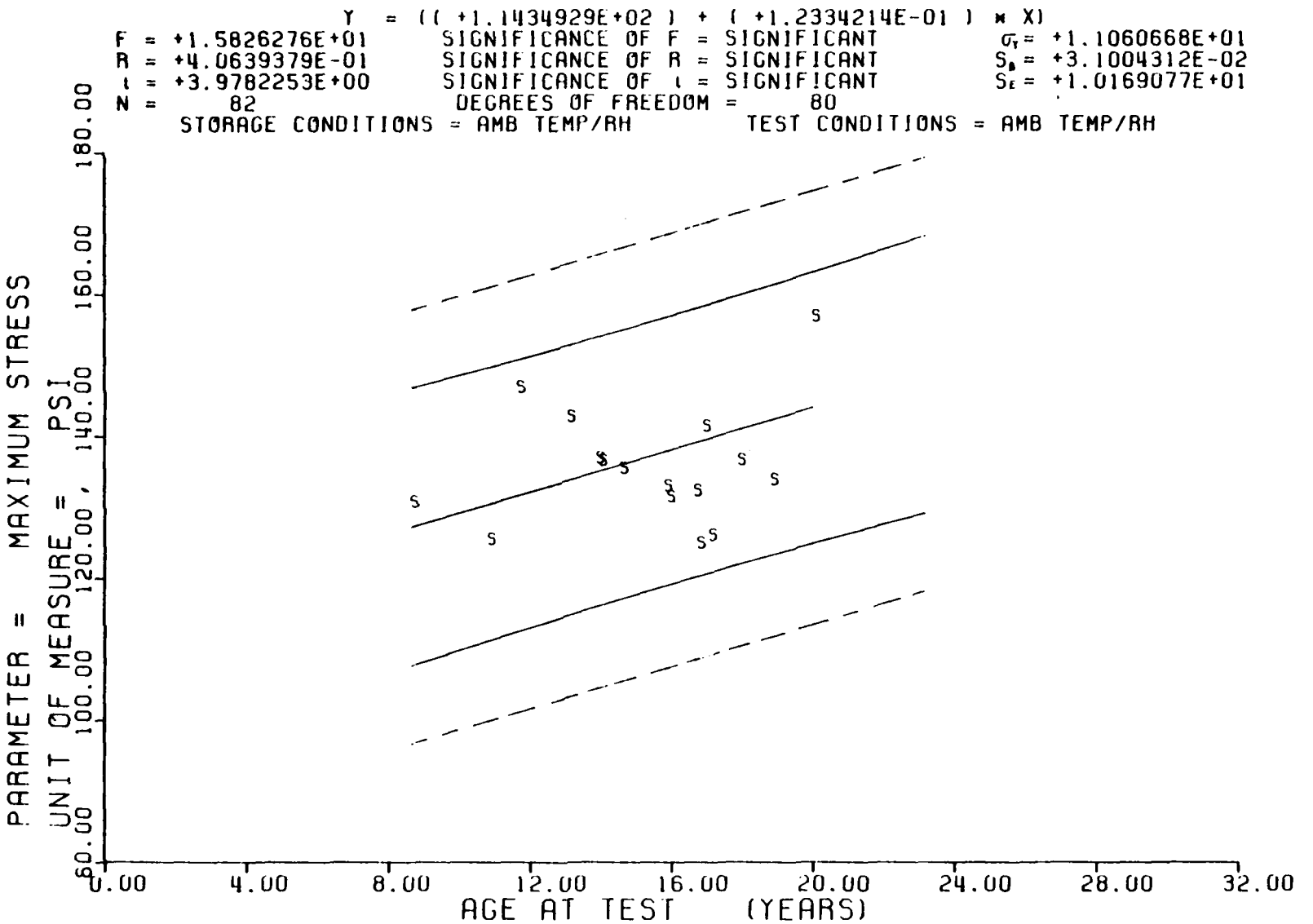
N = 81 DEGREES OF FREEDOM = 79

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



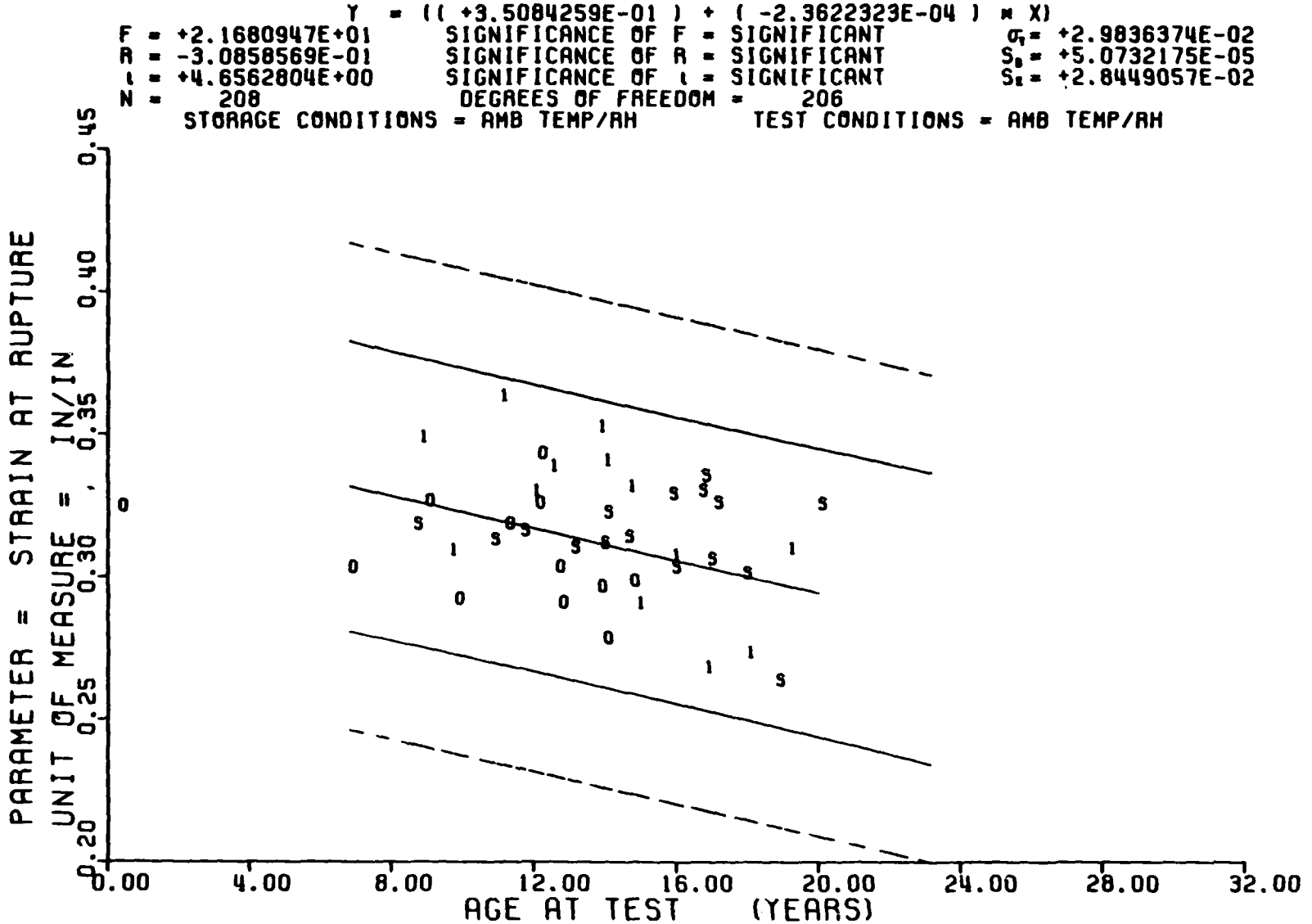
STAGE 1,DISSECTED MOTOR-0012199,LOW RATE CHS=20.0 IN/MIN,MAX STRESS.

Figure 7B



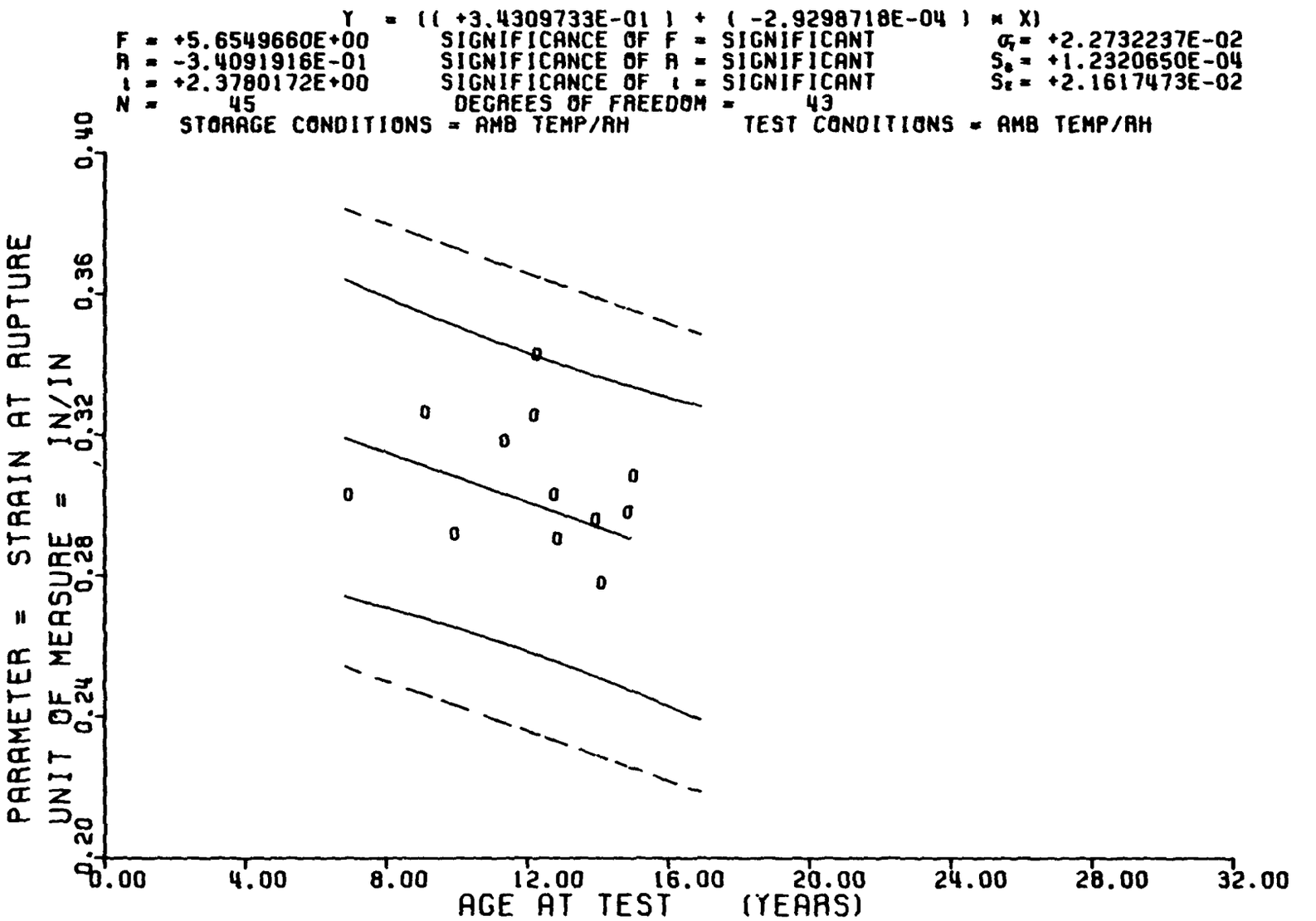
STAGE 1,DISSECTED MOTOR=STM-012,LOW RATE CHS=20.0 IN/MIN,MAX STRESS.

Figure 7C



STAGE 1 DISSECTED MOTORS, LOW RATE CHS=20.0 IN./MIN, STRAIN AT RUPTURE

Figure 8



STAGE 1 DISSECTED MOTOR=0012099,LOW RATE CHS=20.0 IN/MIN,STRAIN AT RUPTURE

Figure 8A

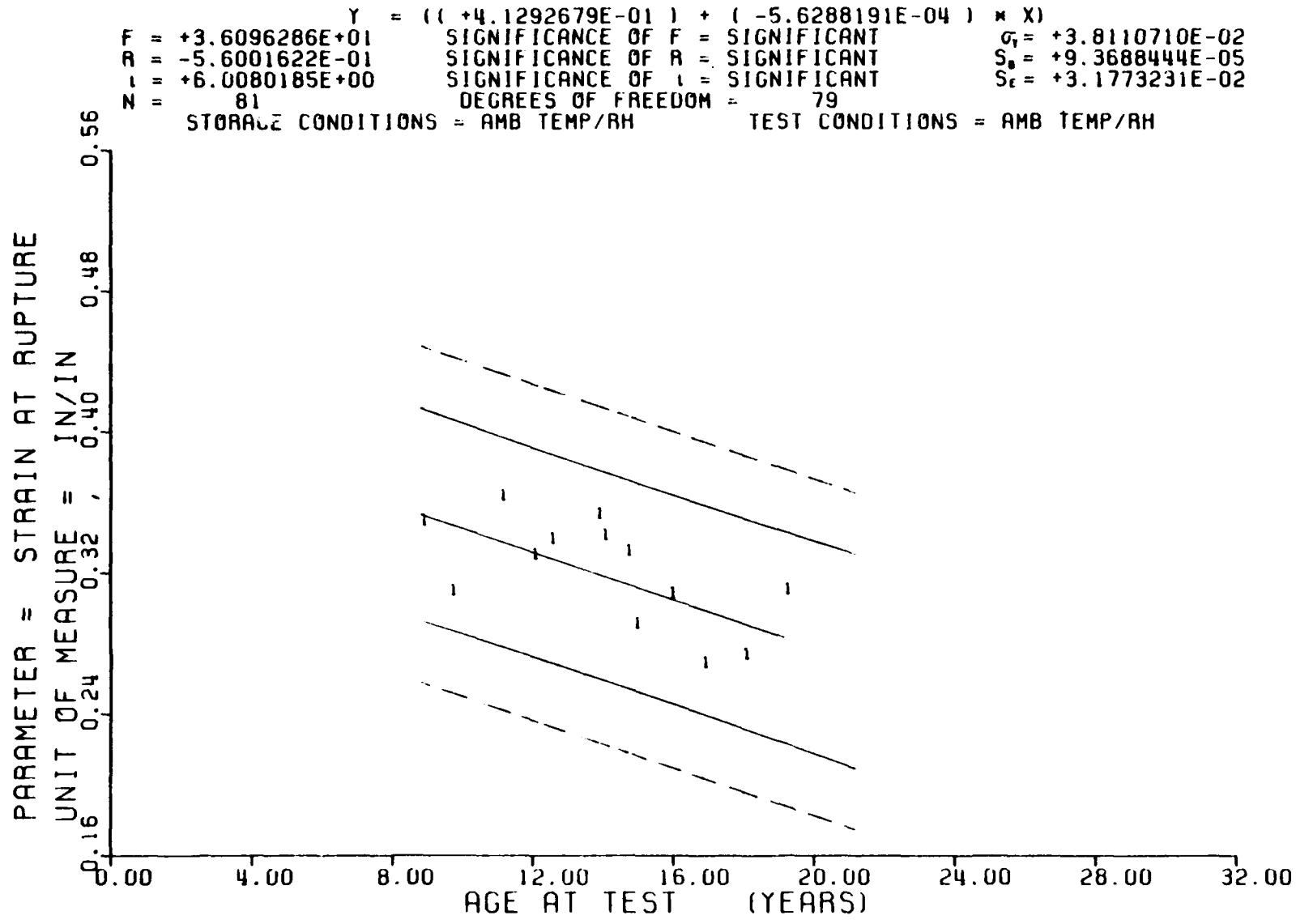

Y = ((+4.1292679E-01) + (-5.6288191E-04) * X)
F = +3.6096286E+01 SIGNIFICANCE OF F = SIGNIFICANT σ_Y = +3.8110710E-02
R = -5.6001622E-01 SIGNIFICANCE OF R = SIGNIFICANT S_B = +9.3688444E-05
t = +6.0080185E+00 SIGNIFICANCE OF t = SIGNIFICANT S_E = +3.1773231E-02
N = 81 DEGREES OF FREEDOM = 79
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT RUPTURE
UNIT OF MEASURE = IN/IN
0.56
0.48
0.40
0.32
0.24
0.16
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1 DISSECTED MOTOR=0012199,LOW RATE CHS=20.0 IN/MIN,STRAIN AT RUPTURE

Figure 8B

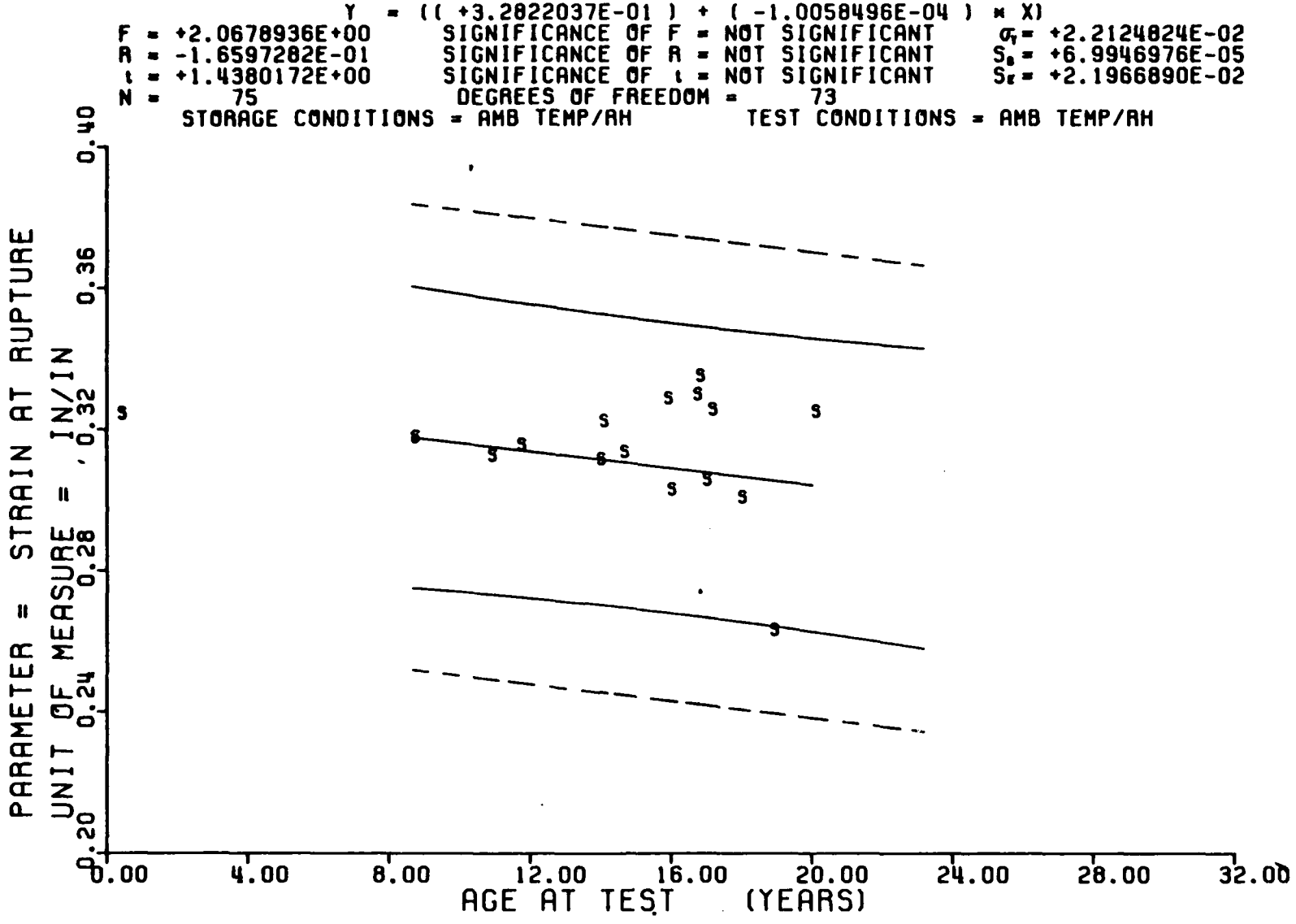

Y = ((+3.2822037E-01) + (-1.0058496E-04) * X)
F = +2.0678936E+00 SIGNIFICANCE OF F = NOT SIGNIFICANT σ_r = +2.2124824E-02
R = -1.6597282E-01 SIGNIFICANCE OF R = NOT SIGNIFICANT S_e = +6.9946976E-05
t = +1.4380172E+00 SIGNIFICANCE OF t = NOT SIGNIFICANT S_E = +2.1966890E-02
N = 75 DEGREES OF FREEDOM = 73
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT RUPTURE
UNIT OF MEASURE = IN/IN
0.40
0.36
0.32
0.28
0.24
0.20
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1 DISSECTED MOTOR=STM-012,LOW RATE CHS=20.0 IN/MIN,STRAIN AT RUPTURE

Figure 8C

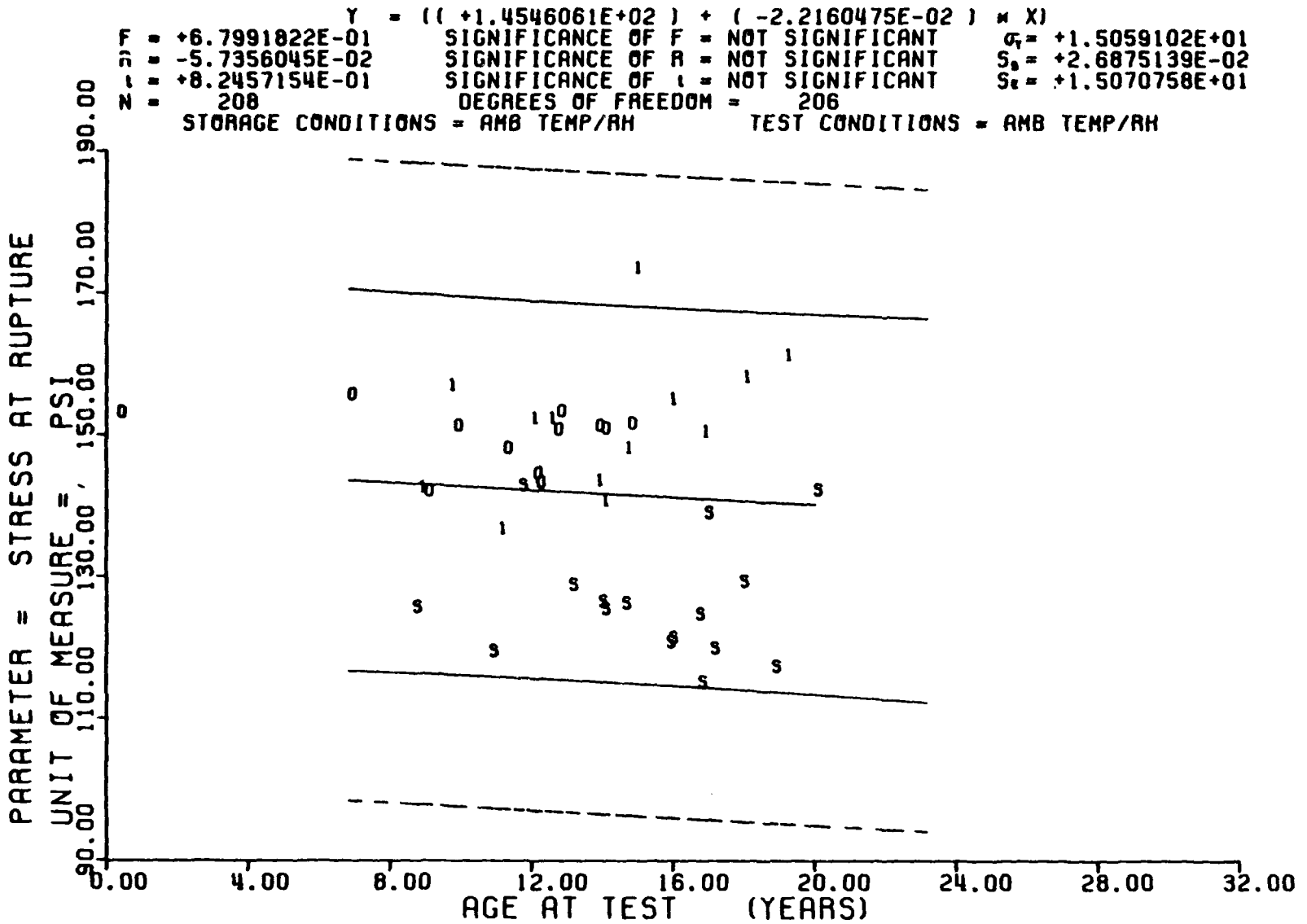

Y = ((+1.4546061E+02) + (-2.2160475E-02) * X)
F = +6.7991822E-01 SIGNIFICANCE OF F = NOT SIGNIFICANT
R = -5.7356045E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT
t = +8.2457154E-01 SIGNIFICANCE OF t = NOT SIGNIFICANT
N = 208 DEGREES OF FREEDOM = 206
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRESS AT RUPTURE
UNIT OF MEASURE = PSI
190.00
170.00
150.00
130.00
110.00
90.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1 DISSECTED MOTORS,LOW RATE CHS=20.0 IN/MIN,STRESS AT RUPTURE

Figure 9

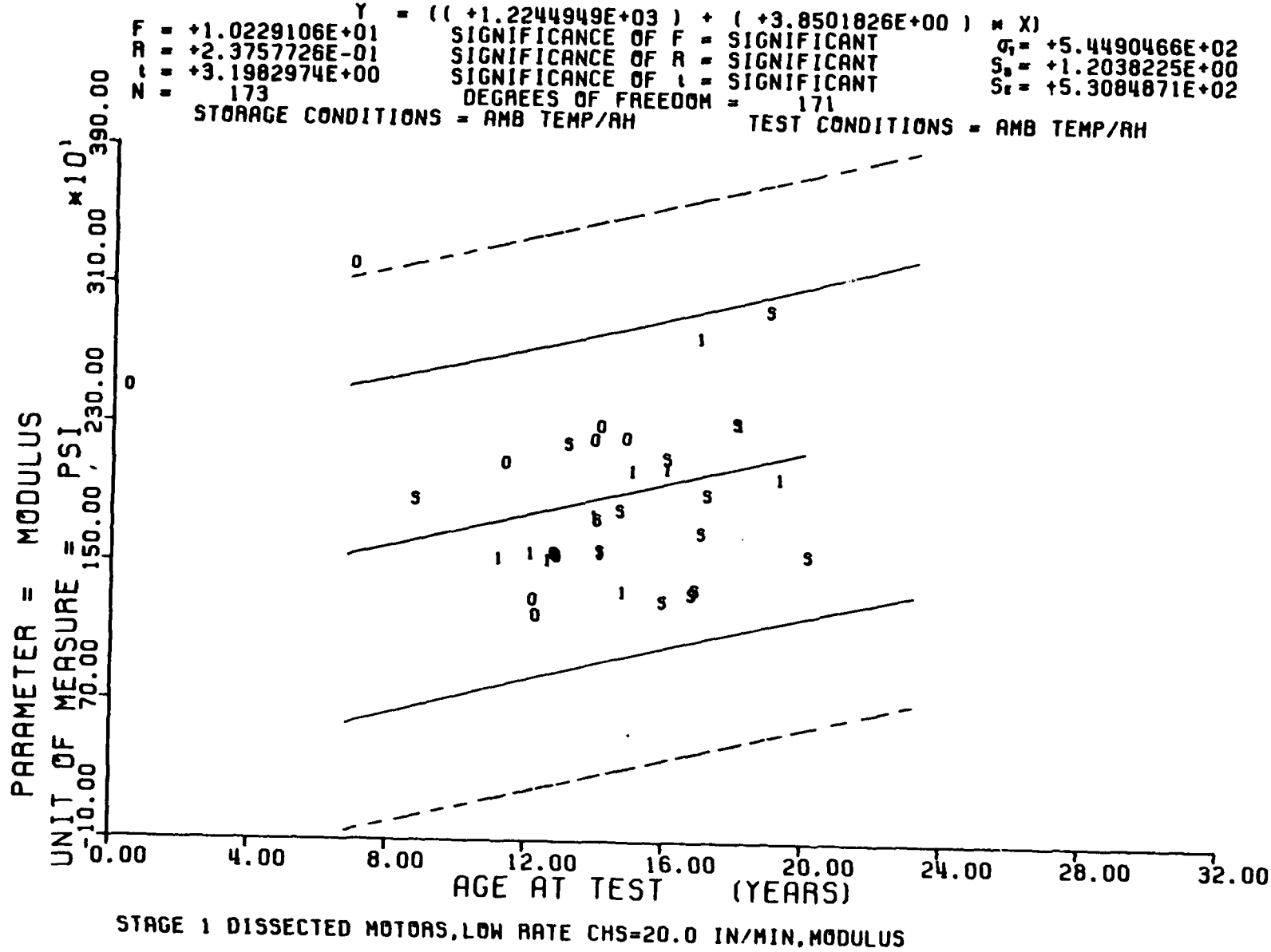
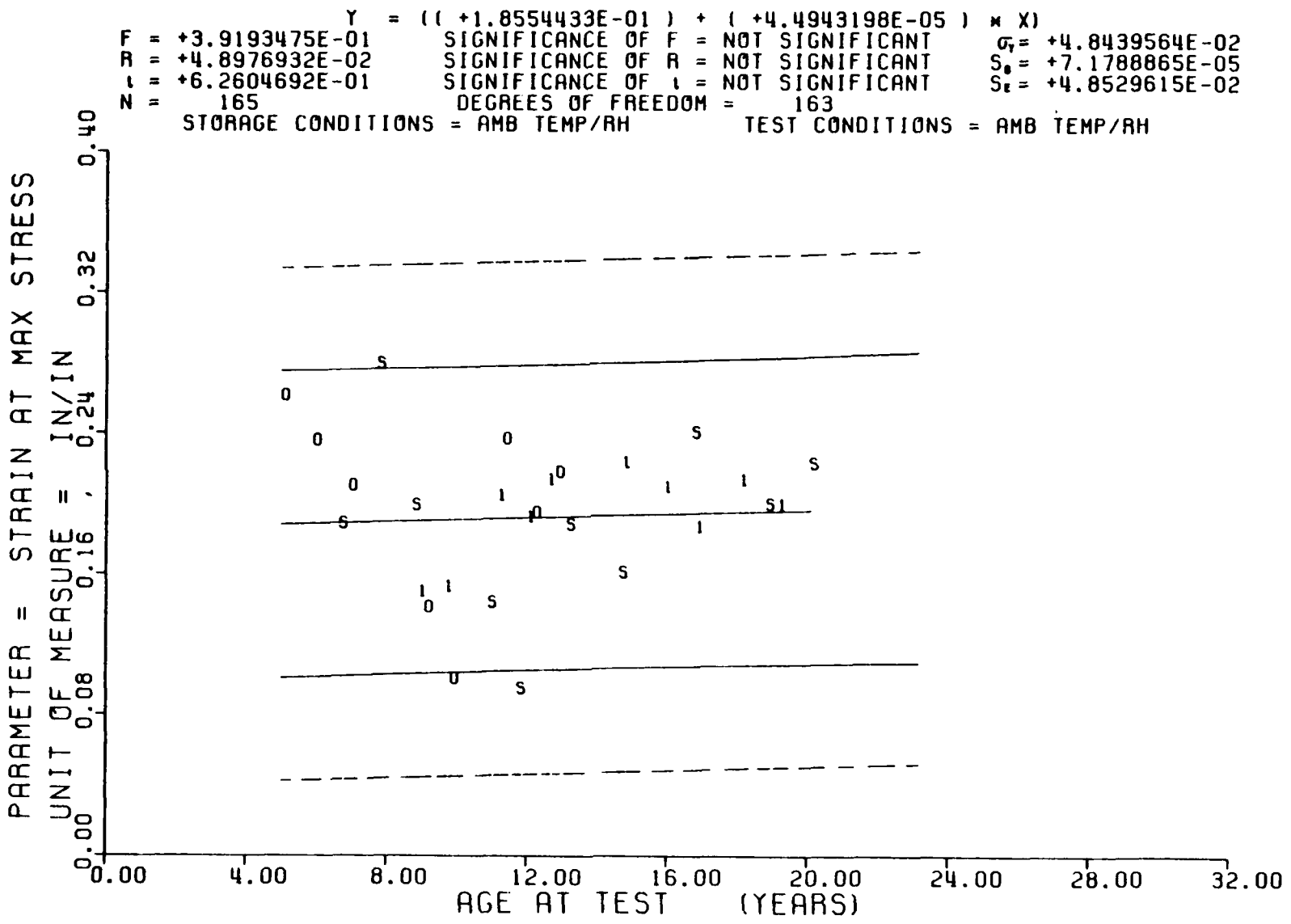
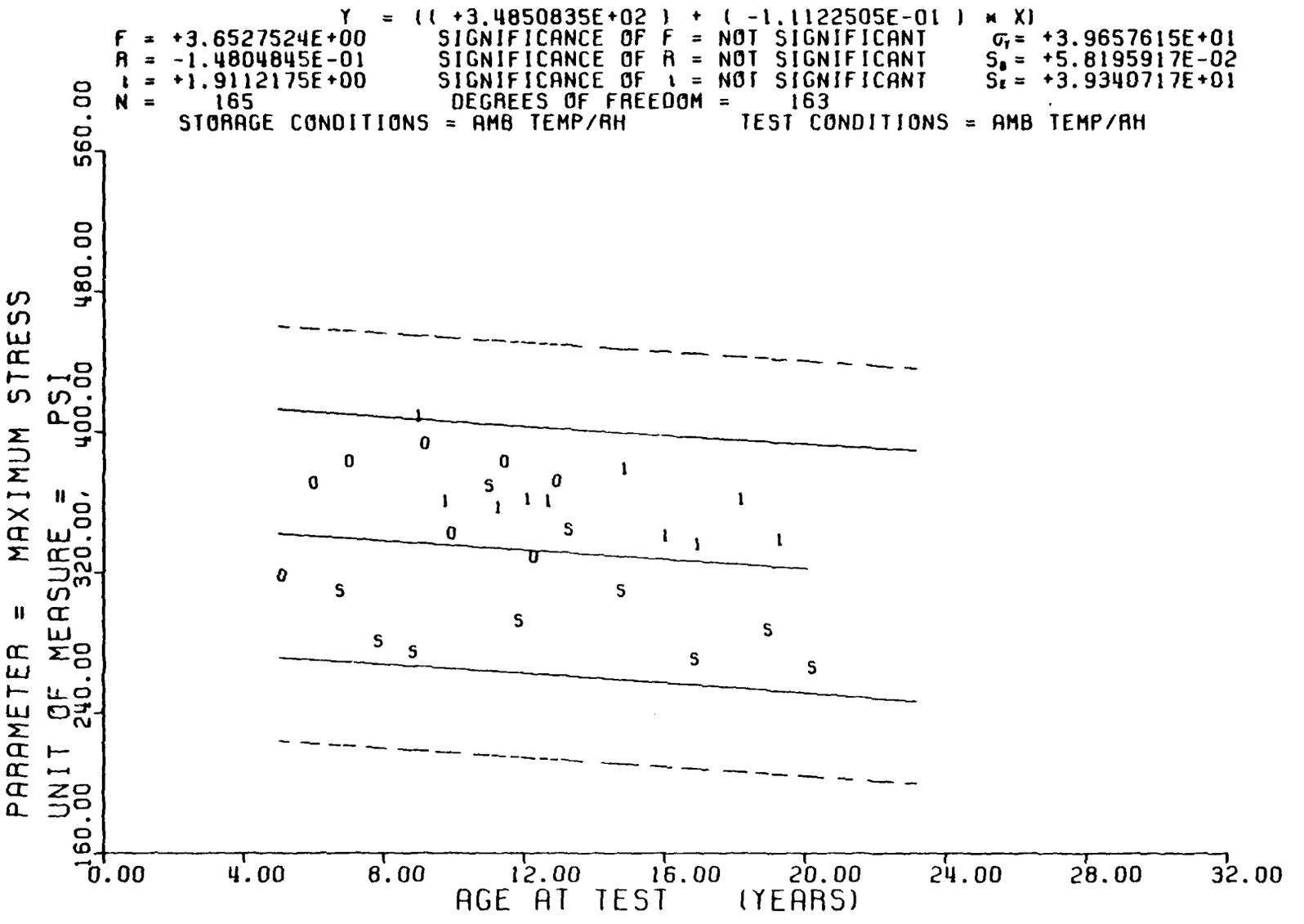

Y = ((+1.2244949E+03) + (+3.8501826E+00) * X)
F = +1.0229106E+01 SIGNIFICANCE OF F = SIGNIFICANT
R = +2.3757726E-01 SIGNIFICANCE OF R = SIGNIFICANT
t = +3.1982974E+00 SIGNIFICANCE OF t = SIGNIFICANT
N = 173 DEGREES OF FREEDOM = 171
STORAGE CONDITIONS = AMB TEMP/RH
TEST CONDITIONS = AMB TEMP/RH
σt = +5.4490466E+02
Sb = +1.2038225E+00
Sr = +5.3084871E+02
PARAMETER = MODULUS
UNIT OF MEASURE = PSI x10¹
390.00
310.00
230.00
150.00
70.00
-10.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1 DISSECTED MOTORS,LOW RATE CHS=20.0 IN/MIN,MODULUS

Figure 10



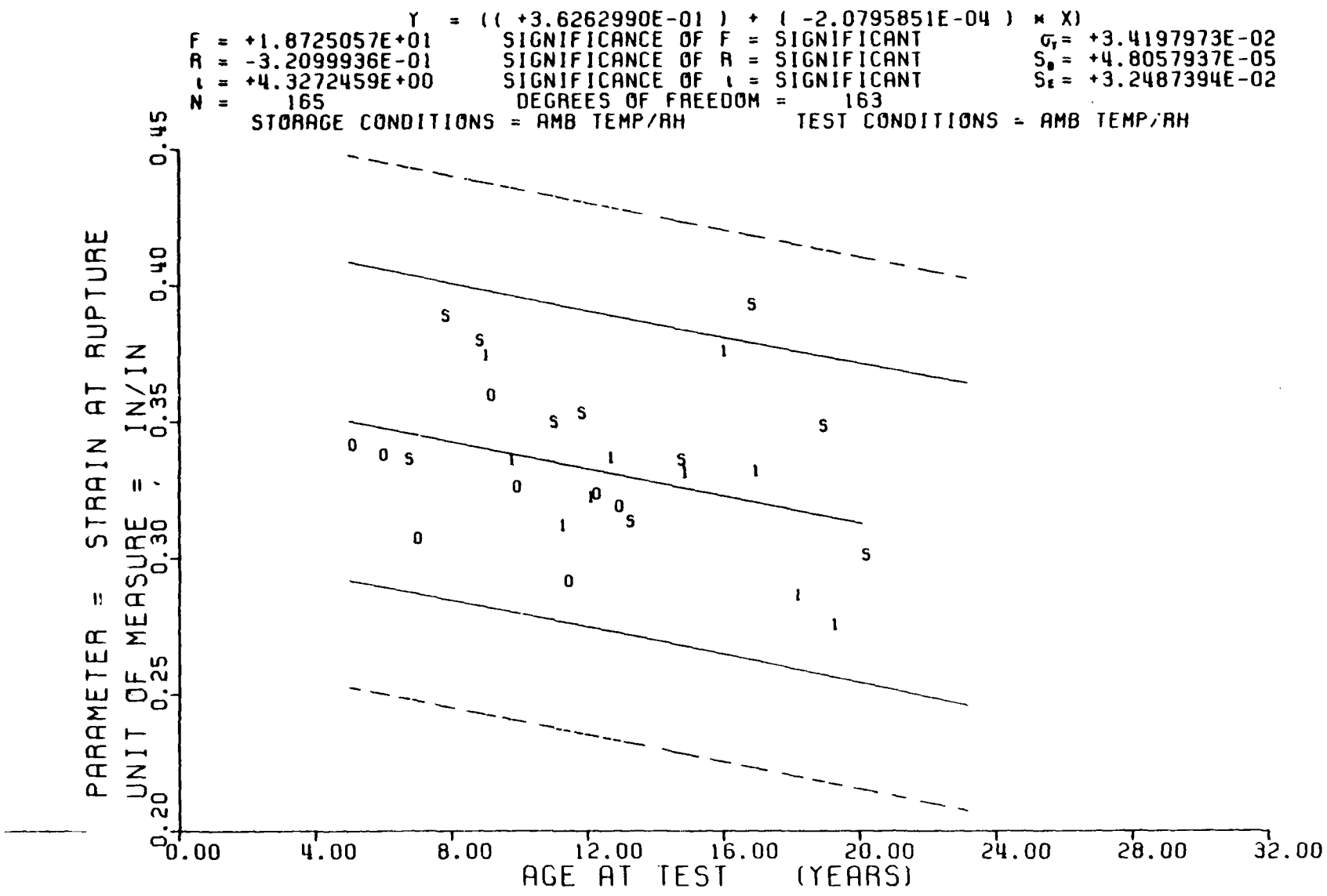
STAGE 1 DISSECTED MOTORS,HIGH RATE CHS=1750 IN/MIN,STRAIN MAX STRESS

Figure 11



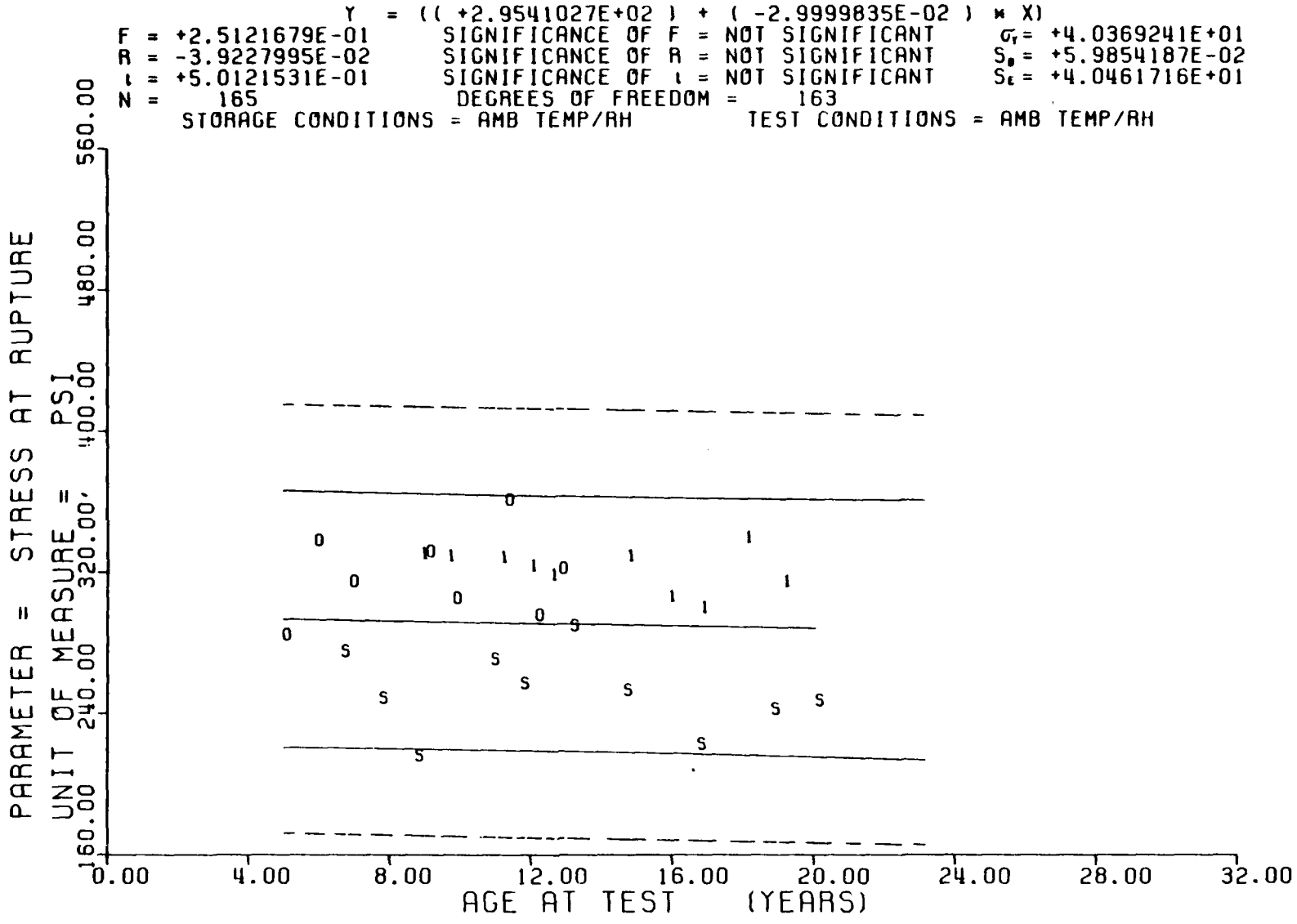
STAGE 1 DISSECTED MOTORS, HIGH RATE CHS=1750 IN/MIN, MAXIMUM STRESS

Figure 12



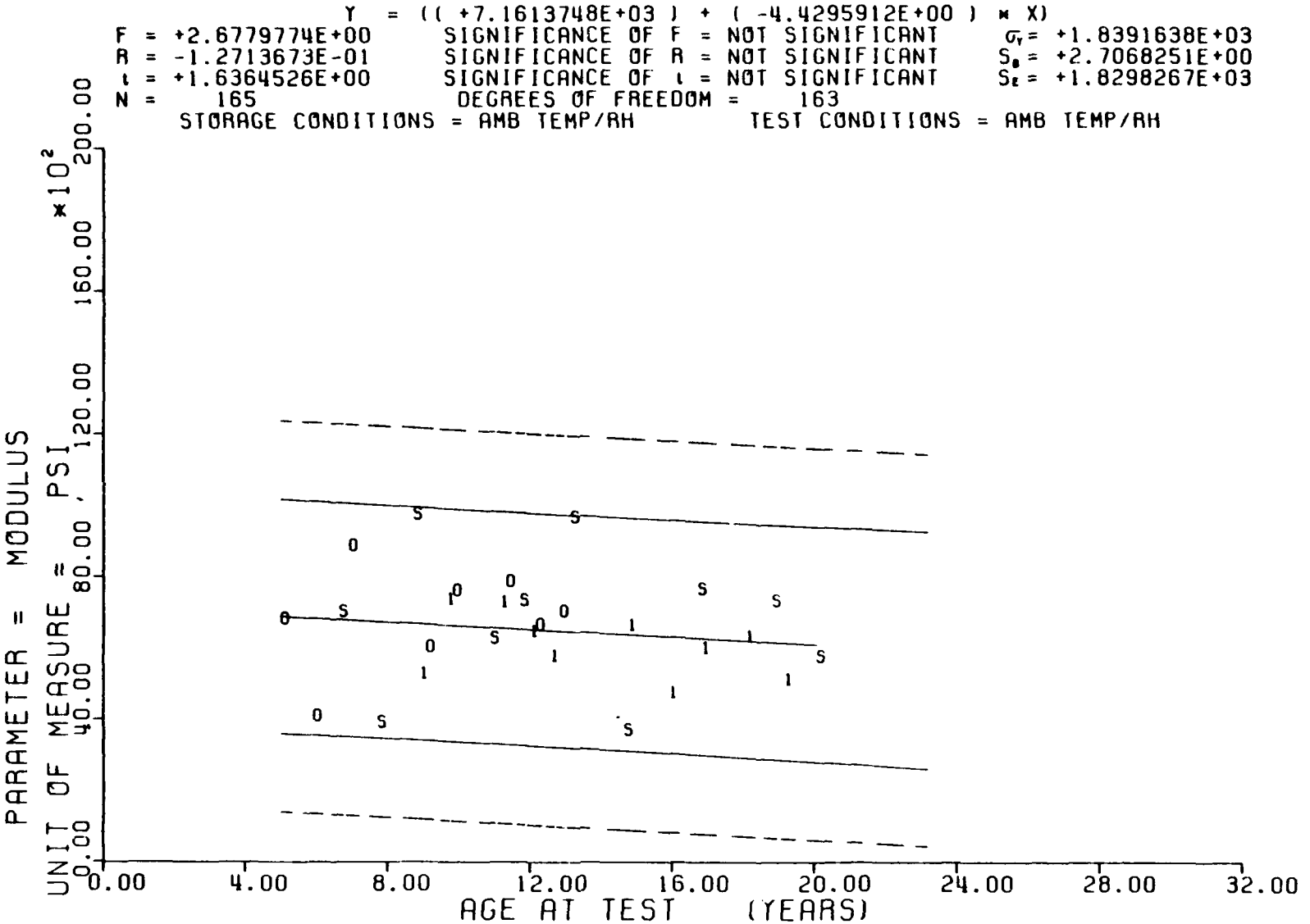
STAGE 1 DISSECTED MOTORS,HIGH RATE CHS=1750 IN/MIN,STRAIN AT RUPTURE

Figure 13



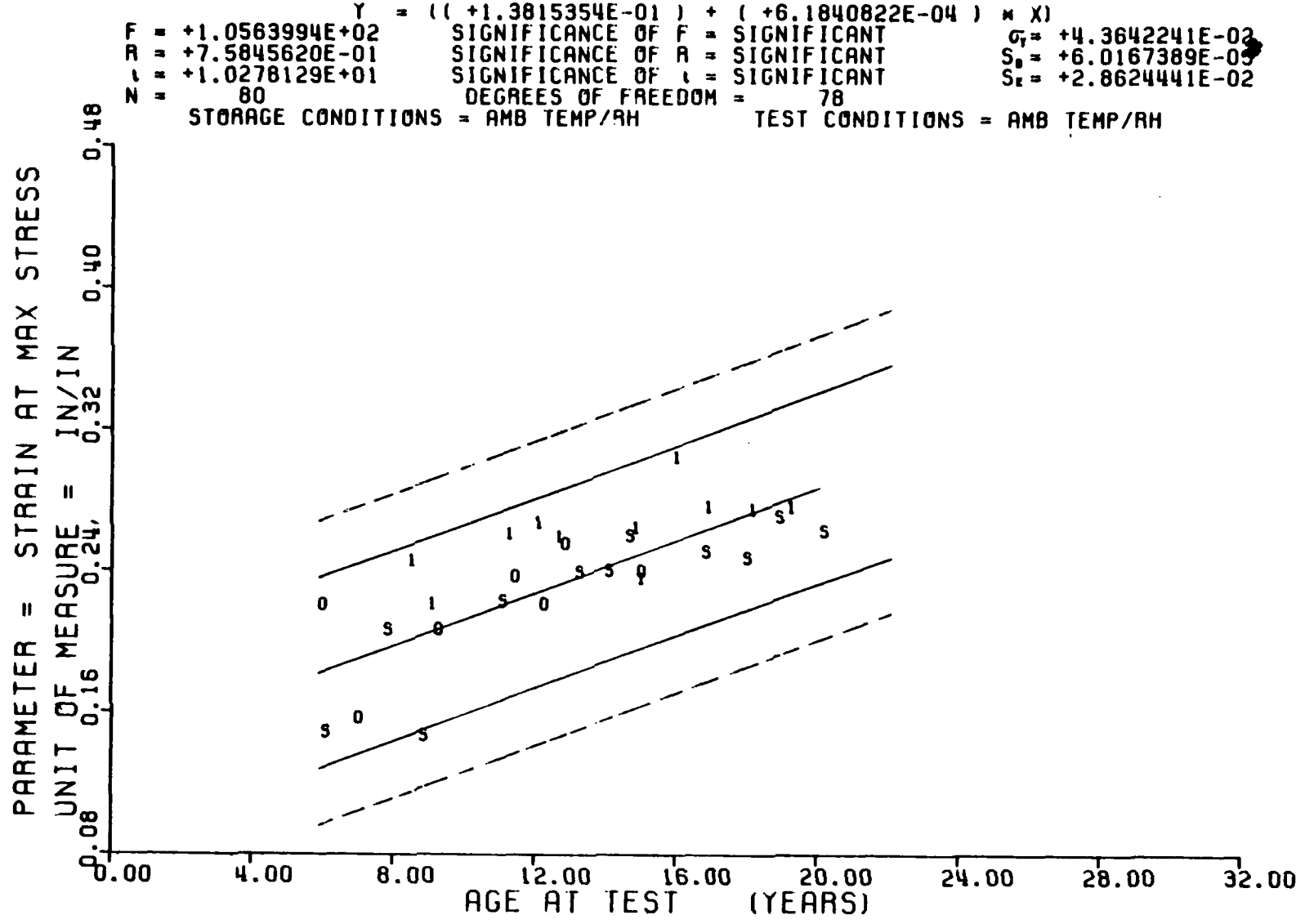
STAGE 1 DISSECTED MOTORS, HIGH RATE CHS=1750 IN/MIN, STRESS AT RUPTURE

Figure 14



STAGE 1 DISSECTED MOTORS, HIGH RATE CHS=1750 IN/MIN, MODULUS

Figure 15



DISSECTED TP-H1011,H.R.TRIAXIAL CHS=1750 IN./MIN,600 PSI,STRAIN MAX STRESS

Figure 16

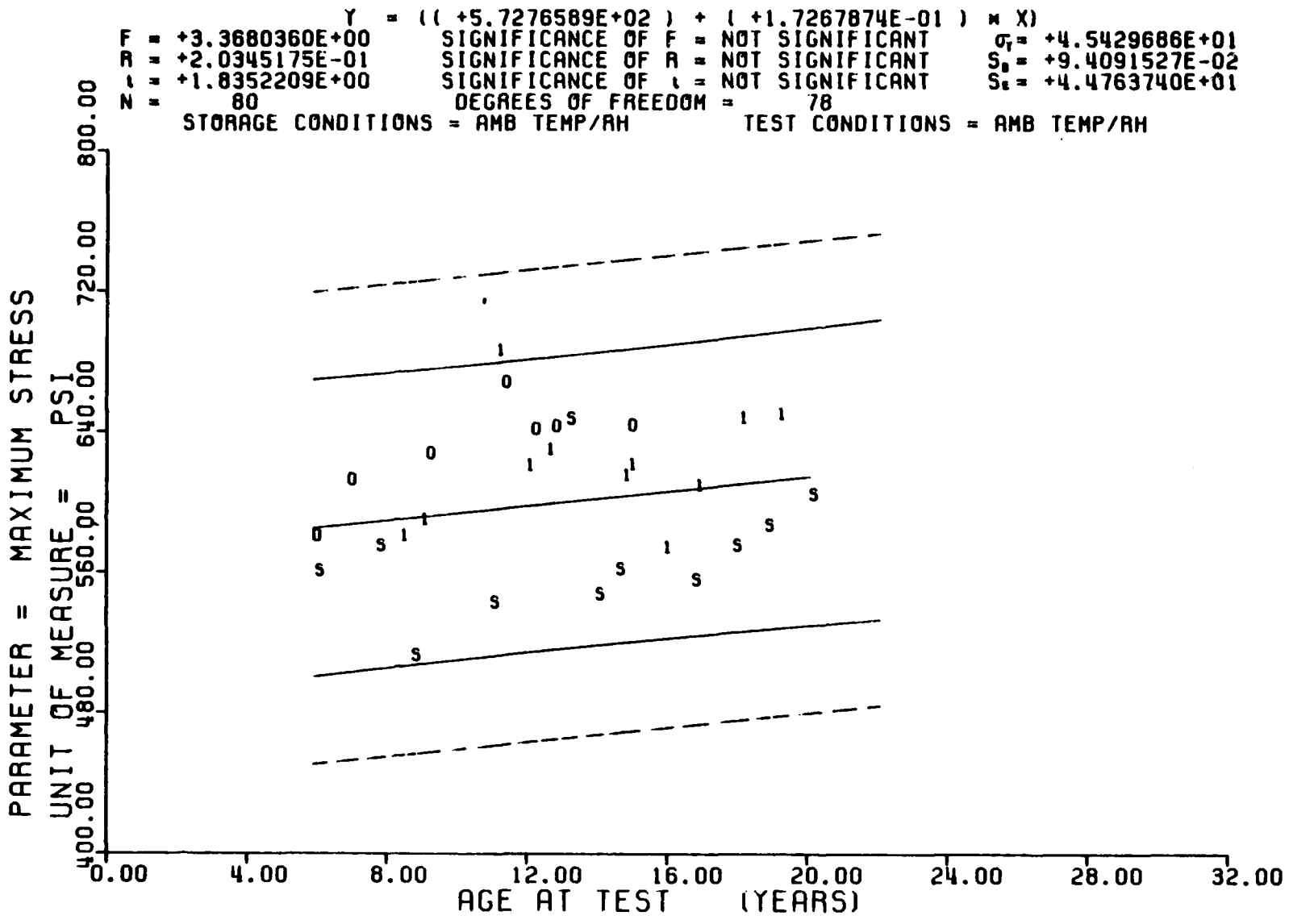

Y = ((+5.7276589E+02) + (+1.7267874E-01) * X)
F = +3.3680360E+00 SIGNIFICANCE OF F = NOT SIGNIFICANT σI = +4.5429686E+01
R = +2.0345175E-01 SIGNIFICANCE OF R = NOT SIGNIFICANT Sβ = +9.4091527E-02
t = +1.8352209E+00 SIGNIFICANCE OF t = NOT SIGNIFICANT Sε = +4.4763740E+01
N = 80 DEGREES OF FREEDOM = 78
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = MAXIMUM STRESS
UNIT OF MEASURE = PSI
800.00
720.00
640.00
560.00
480.00
400.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
DISSECTED TP-H1011,H.R.TRIAXIAL CHS=1750 IN/MIN,600 PSI,MAXIMUM STRESS

Figure 17

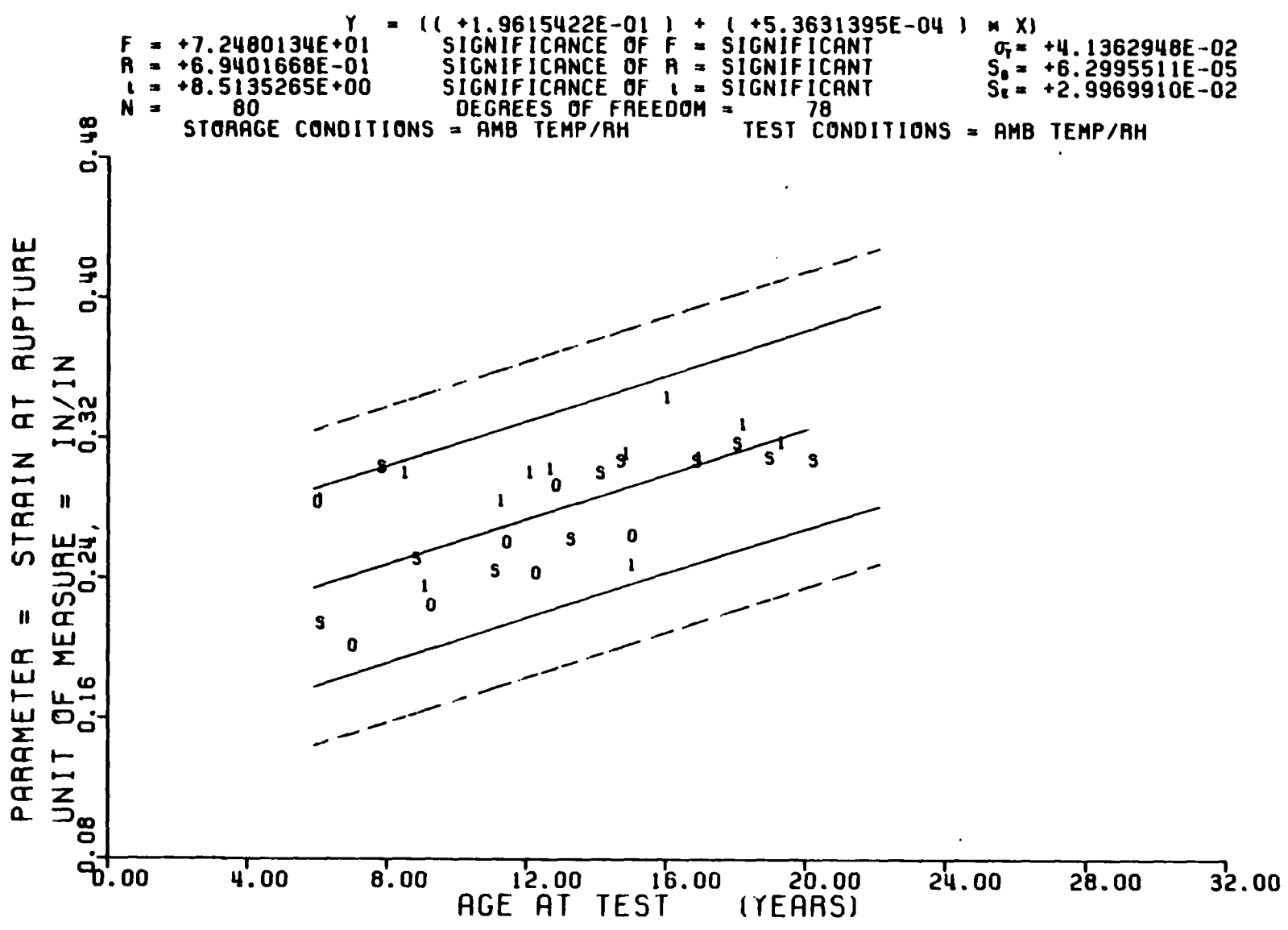

Y = ((+1.9615422E-01) + (+5.3631395E-04) * X)
F = +7.2480134E+01 SIGNIFICANCE OF F = SIGNIFICANT σr = +4.1362948E-02
R = +6.9401668E-01 SIGNIFICANCE OF R = SIGNIFICANT Sb = +6.2995511E-05
t = +8.5135265E+00 SIGNIFICANCE OF t = SIGNIFICANT St = +2.9969910E-02
N = 80 DEGREES OF FREEDOM = 78
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT RUPTURE
UNIT OF MEASURE = IN/IN
0.08
0.16
0.24
0.32
0.40
0.48
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
DISSECTED TP-H1011,H.R.TRIAXIAL CHS=1750 IN/MIN,600 PSI,STRAIN AT RUPTURE

Figure 18

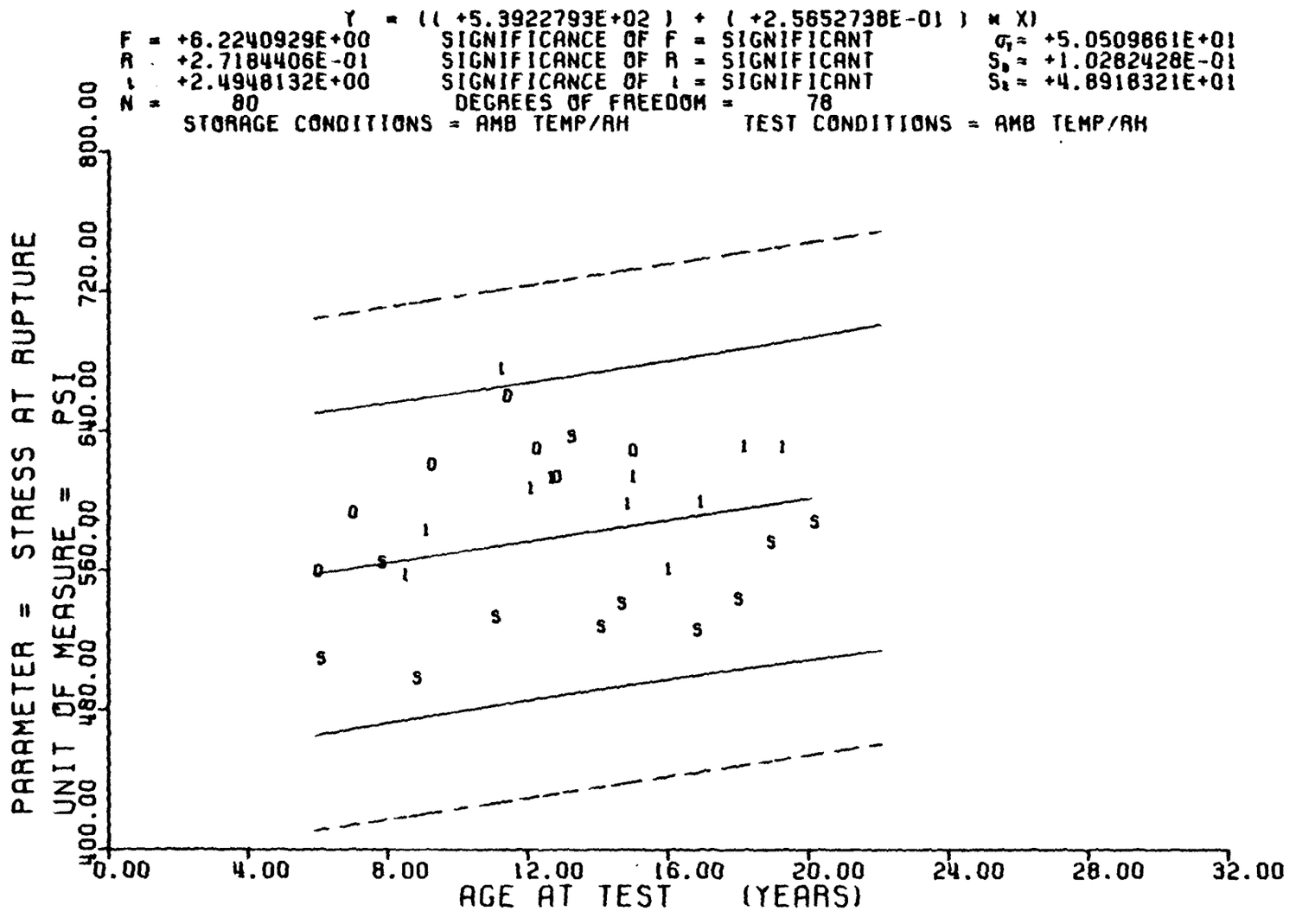
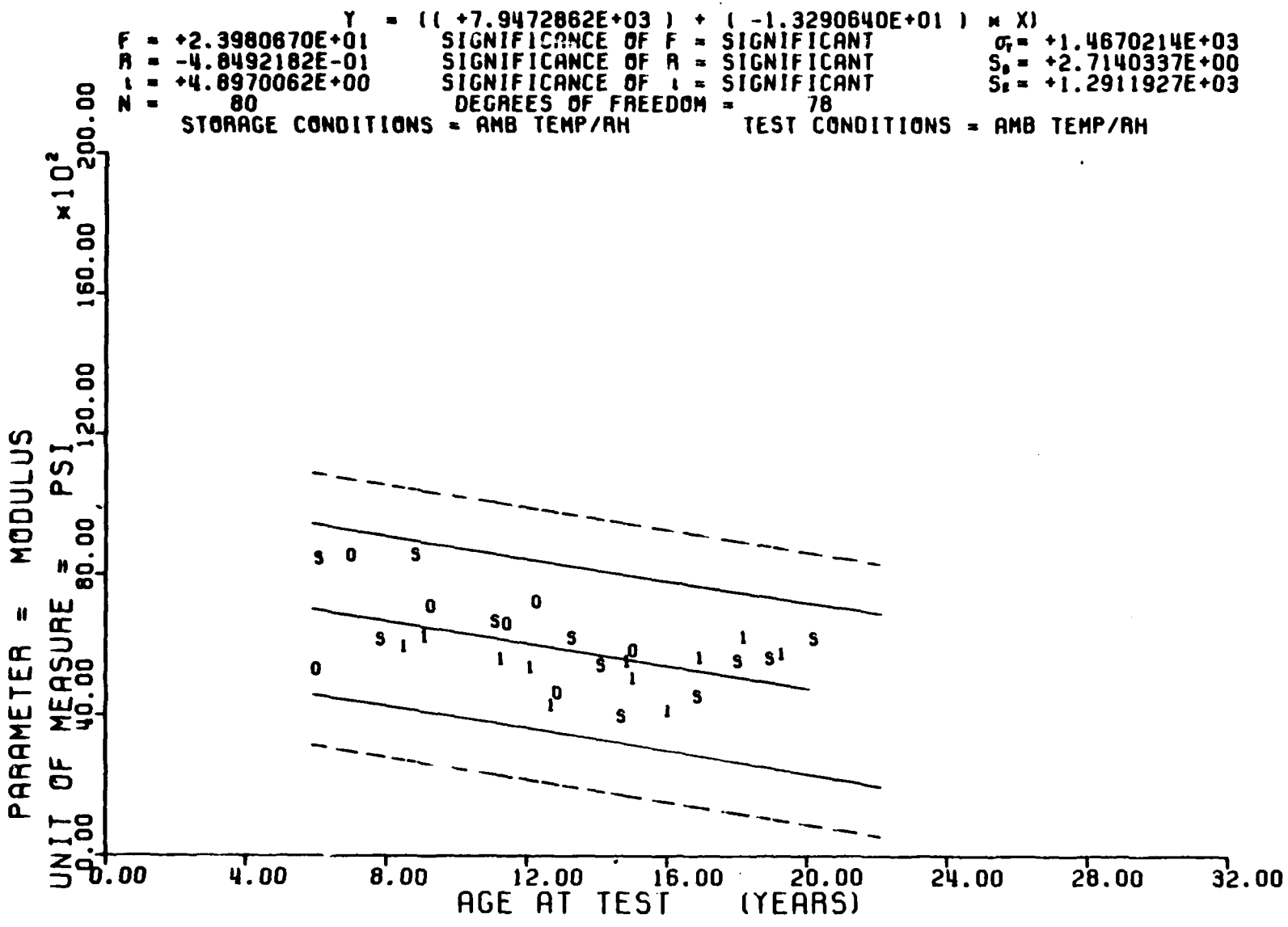
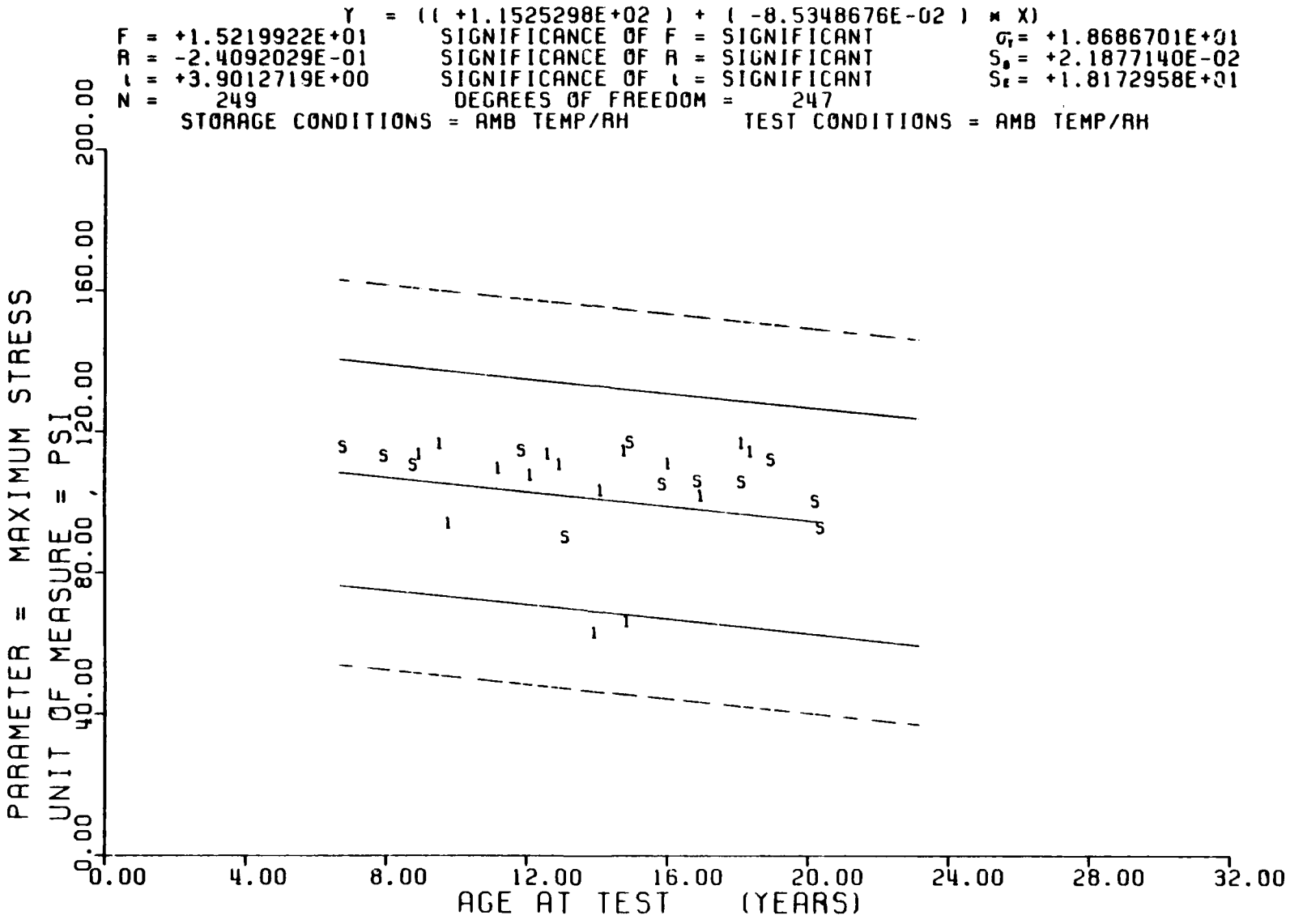

Y = ((+5.3922793E+02) + (+2.5652738E-01) * X)
F = +6.2240929E+00 SIGNIFICANCE OF F = SIGNIFICANT σ = +5.0509861E+01
R = +2.7184406E-01 SIGNIFICANCE OF R = SIGNIFICANT S = +1.0282428E-01
t = +2.4948132E+00 SIGNIFICANCE OF t = SIGNIFICANT S = +4.8918321E+01
N = 80 DEGREES OF FREEDOM = 78
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRESS AT RUPTURE
UNIT OF MEASURE = PSI
400.00
480.00
560.00
640.00
720.00
800.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
DISSECTED TP-H1011,H.R.TRIAXIAL CHS=1750 IN/MIN,600 PSI,STRESS AT RUPTURE

Figure 19



DISSECTED TP-H1011,H.R.TRIAXIAL CHS=1750 IN/MIN,600 PSI,MODULUS

Figure 20



CASEBOND TENSILE, STAGE 1 DISSECTED, CHS 0.2, CSA 0.75

Figure 21

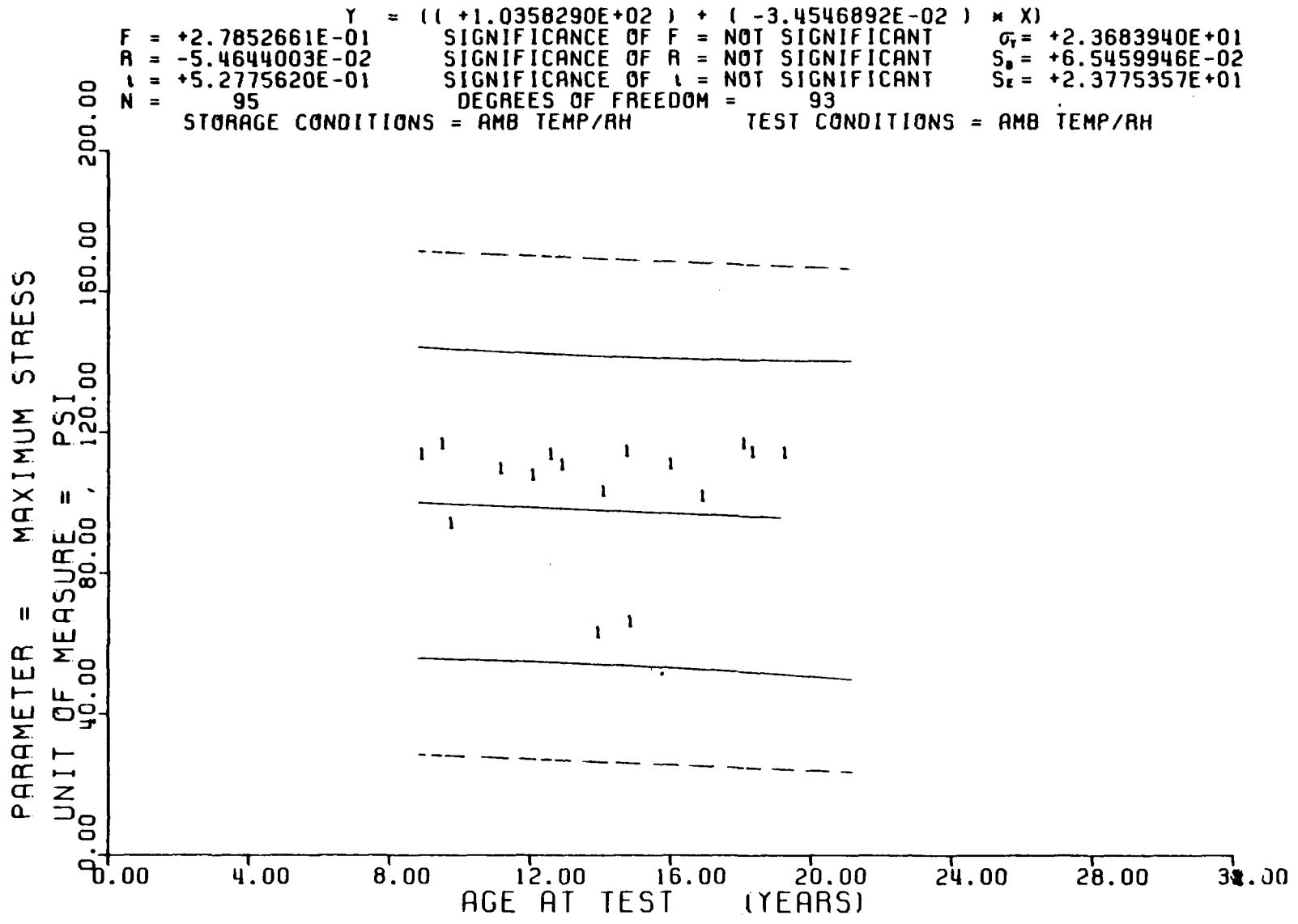

Y = ((+1.0358290E+02) + (-3.4546892E-02) * X)
F = +2.7852661E-01 SIGNIFICANCE OF F = NOT SIGNIFICANT σT = +2.3683940E+01
R = -5.4644003E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT Sb = +6.5459946E-02
t = +5.2775620E-01 SIGNIFICANCE OF t = NOT SIGNIFICANT Se = +2.3775357E+01
N = 95 DEGREES OF FREEDOM = 93
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = MAXIMUM STRESS
UNIT OF MEASURE = PSI
200.00
160.00
120.00
80.00
40.00
0.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
AGE AT TEST (YEARS)
STAGE 1,DISSECTED MOTOR=0012199,CASE BOND TENSILE,CHS=0.2 IN/MIN,T/TEMP=77 DEG

Figure 21A

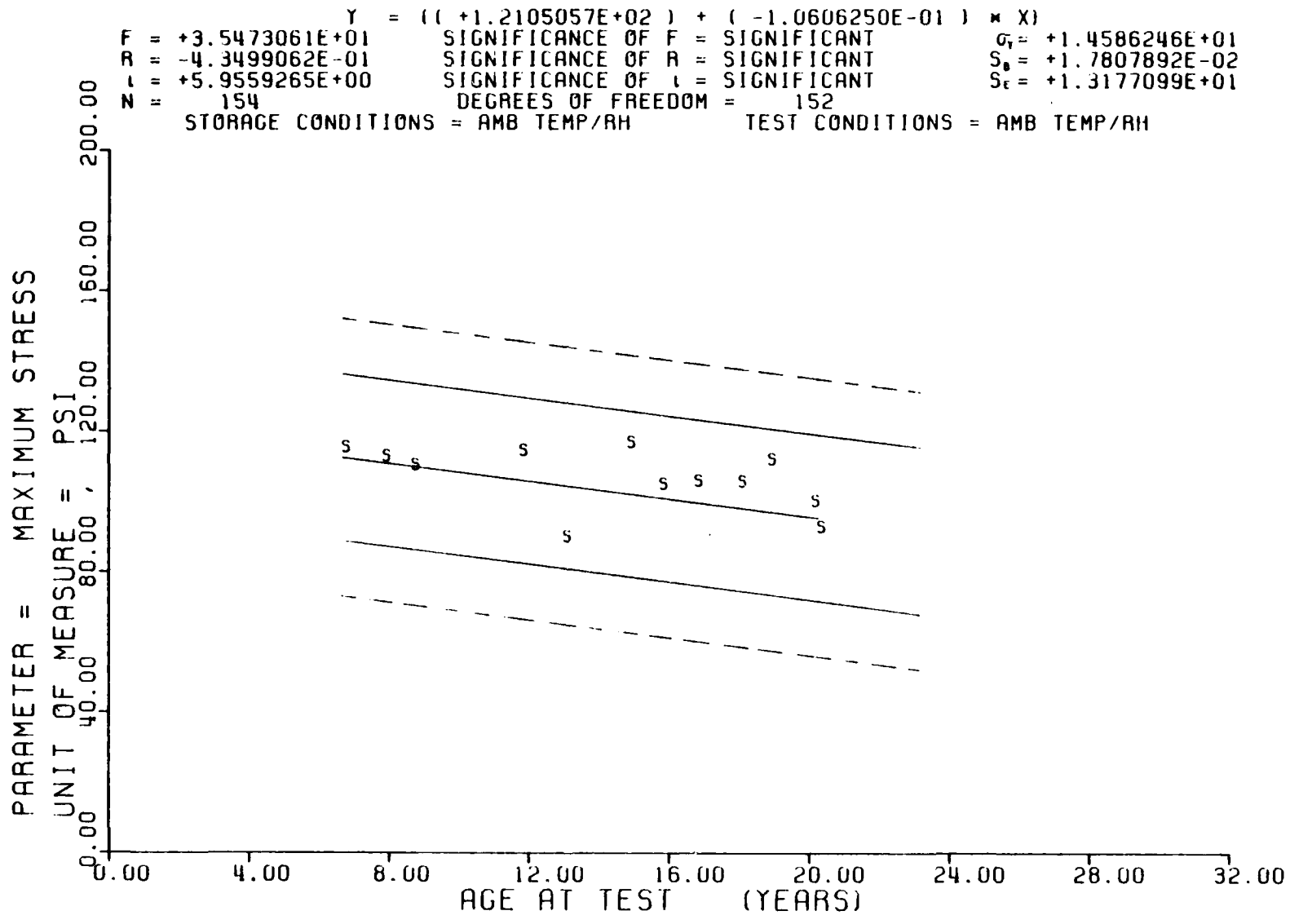
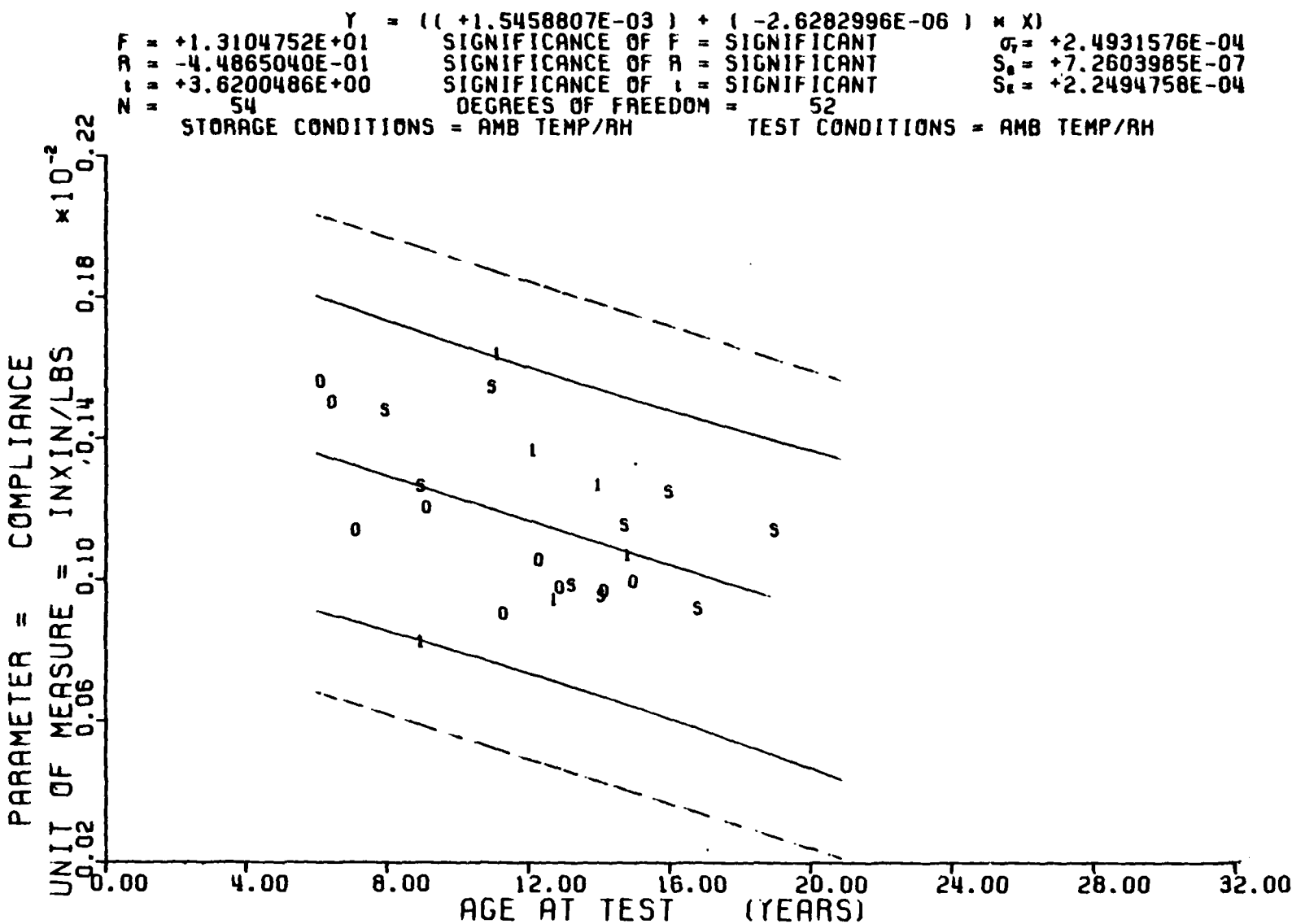
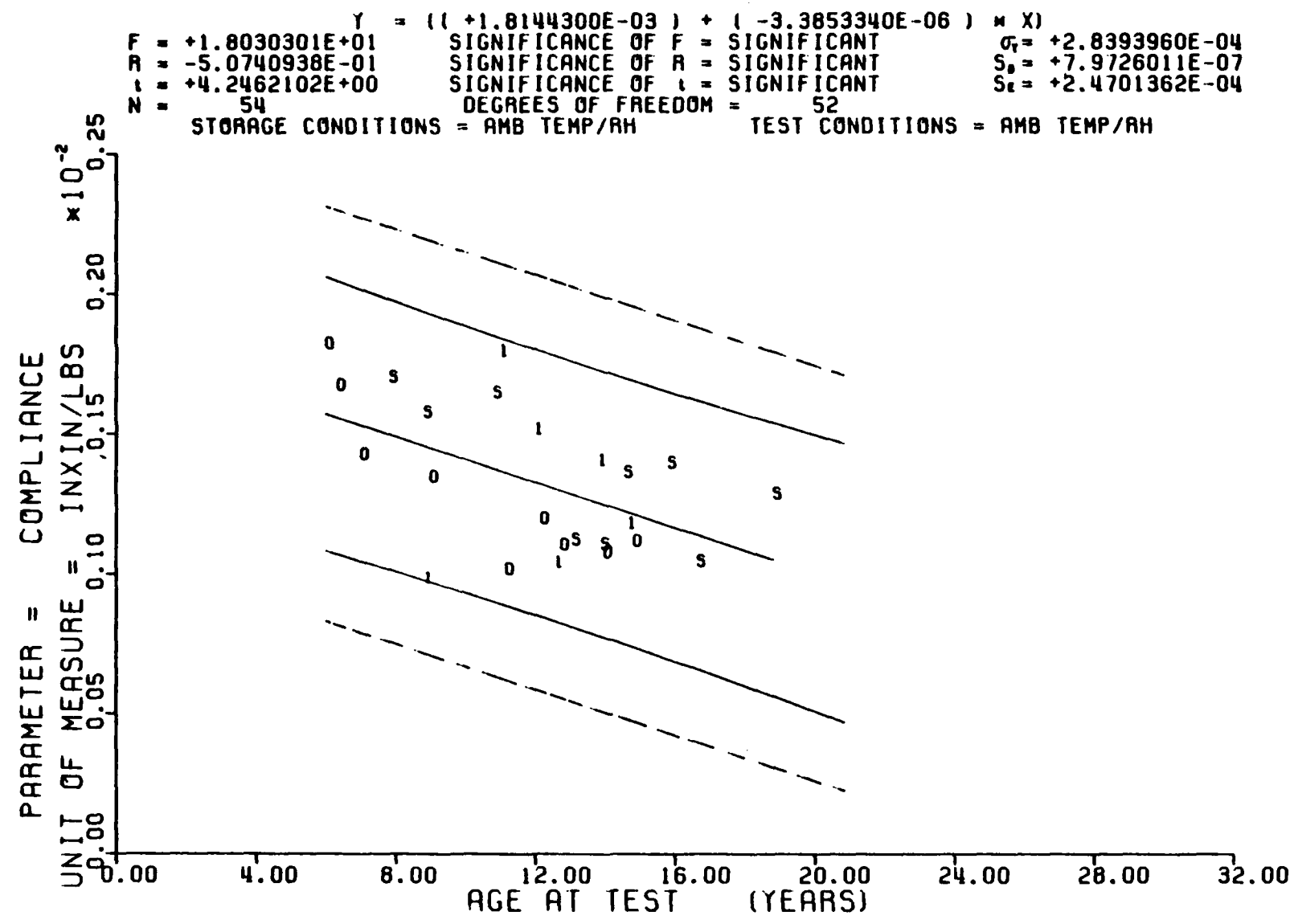

Y = ((+1.2105057E+02) + (-1.0606250E-01) * X)
F = +3.5473061E+01 SIGNIFICANCE OF F = SIGNIFICANT σt = +1.4586246E+01
R = -4.3499062E-01 SIGNIFICANCE OF R = SIGNIFICANT Sb = +1.7807892E-02
ι = +5.9559265E+00 SIGNIFICANCE OF ι = SIGNIFICANT Sε = +1.3177099E+01
N = 154 DEGREES OF FREEDOM = 152
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = MAXIMUM STRESS
UNIT OF MEASURE = PSI
200.00
160.00
120.00
80.00
40.00
0.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,DISSECTED MOTOR=STM-012,CASE BOND TENSILE,CHS=0.2 IN/MIN,T/TEMP=77 DEG

Figure 21B



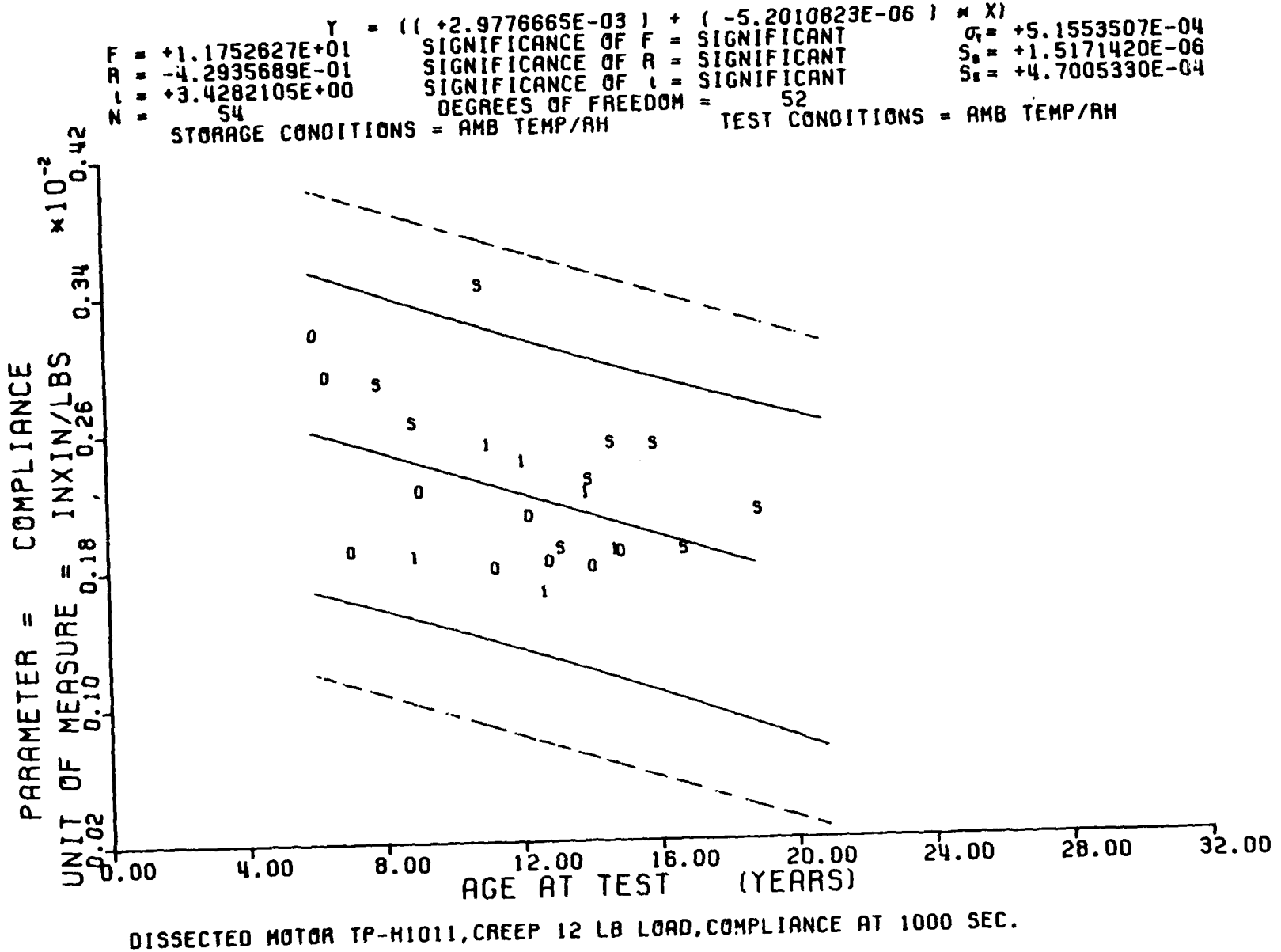
DISSECTED MOTOR TP-H1011, CREEP 12 LB LOAD, COMPLIANCE AT 10 SEC.

Figure 22



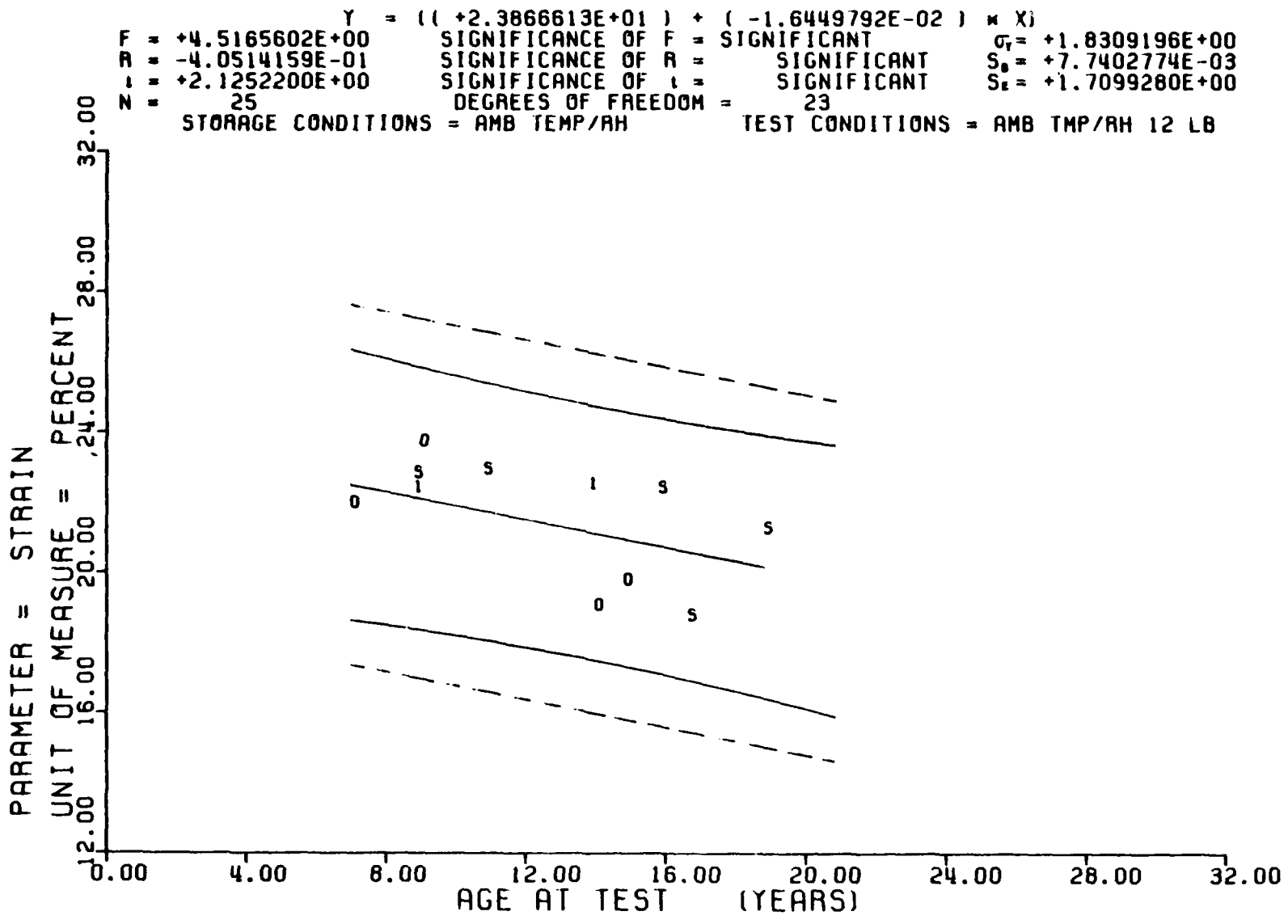
DISSECTED MOTOR TP-H1011, CREEP 12 LB LOAD, COMPLIANCE AT 20 SEC.

Figure 23



DISSECTED MOTOR TP-H1011, CREEP 12 LB LOAD, COMPLIANCE AT 1000 SEC.

Figure 24



TP-H1011 DISSECTED MOTORS, CREEP, % STRAIN AT RUPTURE, 12 LB LOAD

Figure 25

Y = ((+1.3218815E-03) + (-2.2678021E-06) * X)

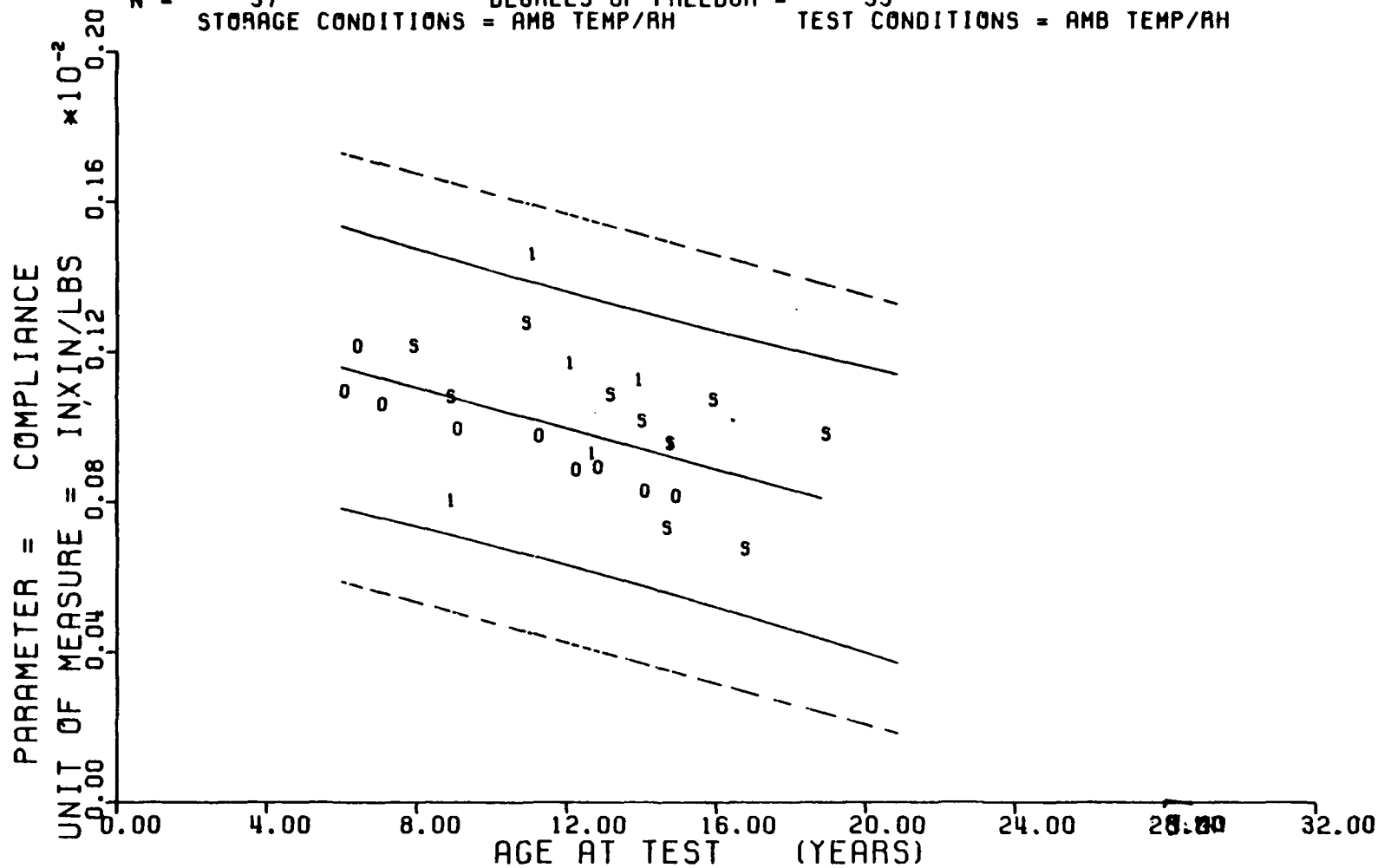
F = +1.2213572E+01 SIGNIFICANCE OF F = SIGNIFICANT σ_1 = +2.0835884E-04

R = -4.2627794E-01 SIGNIFICANCE OF R = SIGNIFICANT S_0 = +6.4890902E-07

t = +3.4947921E+00 SIGNIFICANCE OF t = SIGNIFICANT S_2 = +1.9018552E-04

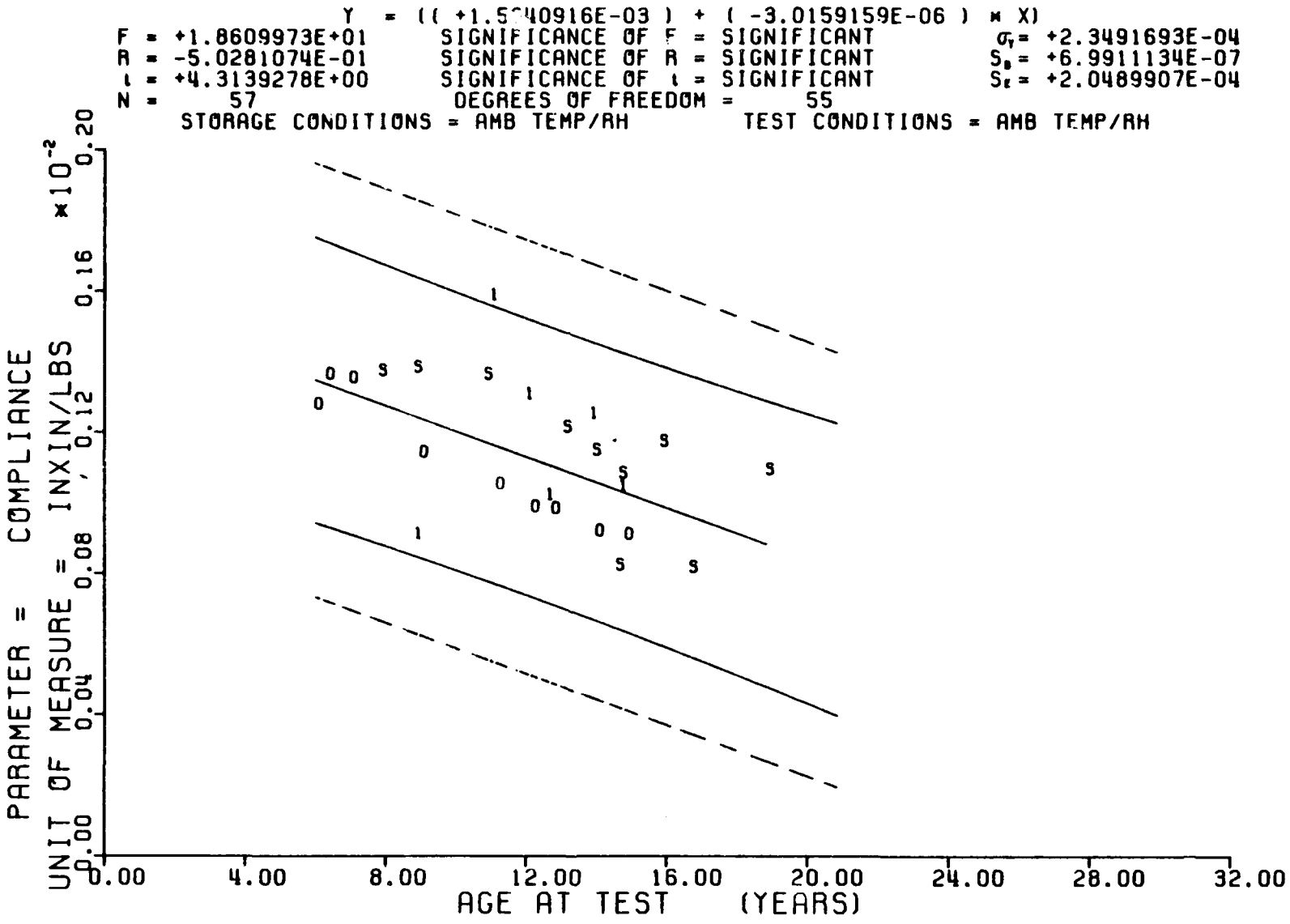
N = 57 DEGREES OF FREEDOM = 55

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



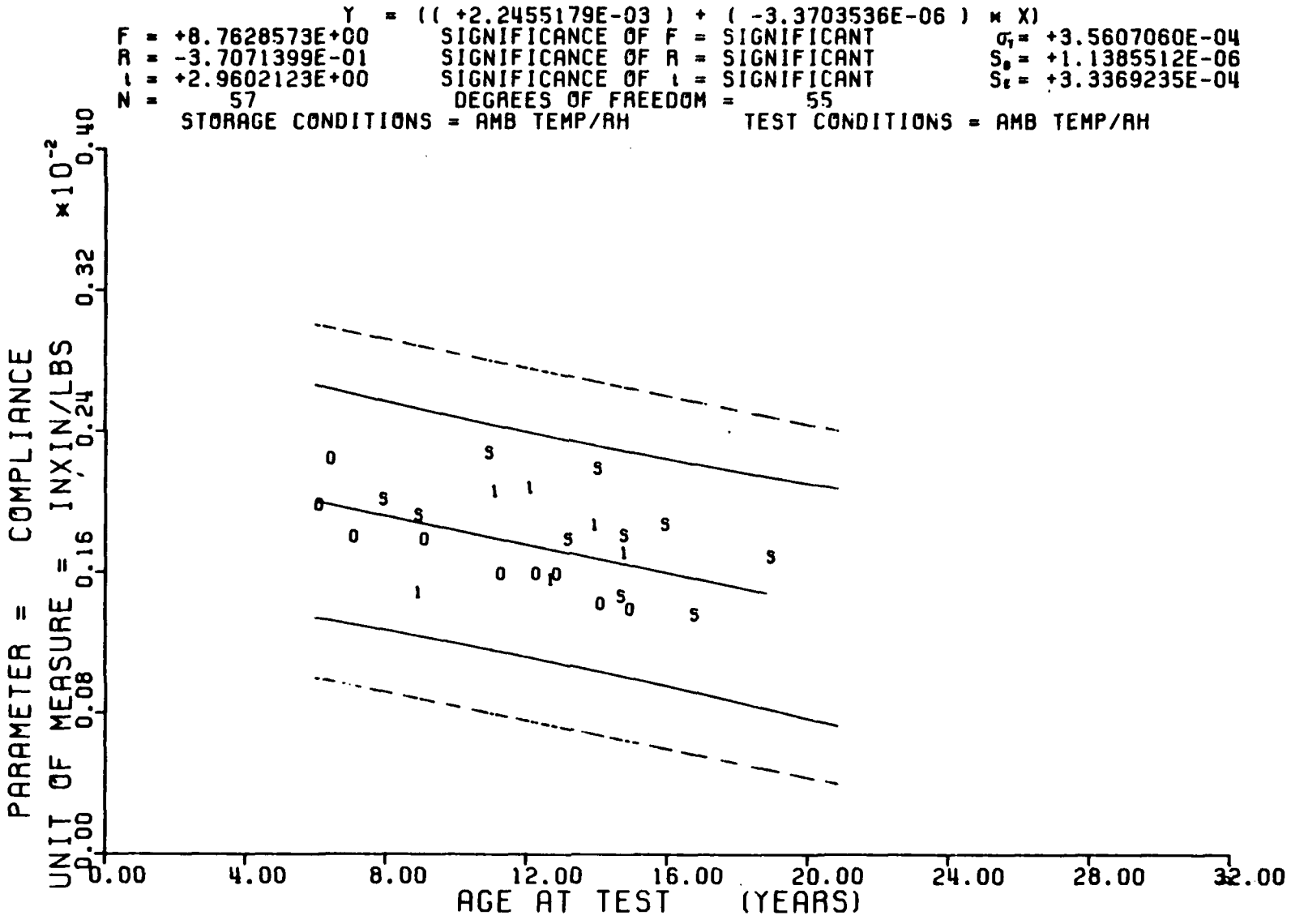
DISSECTED MOTOR TP-H1011,CREEP 10 LB LOAD,COMPLIANCE AT 10 SEC.

Figure 26



DISSECTED MOTOR TP-H1011, CREEP 10 LB LOAD, COMPLIANCE AT 20 SEC.

Figure 27



DISSECTED MOTOR TP-H1011, CREEP 10 LB LOAD, COMPLIANCE AT 1000 SEC.

Figure 28

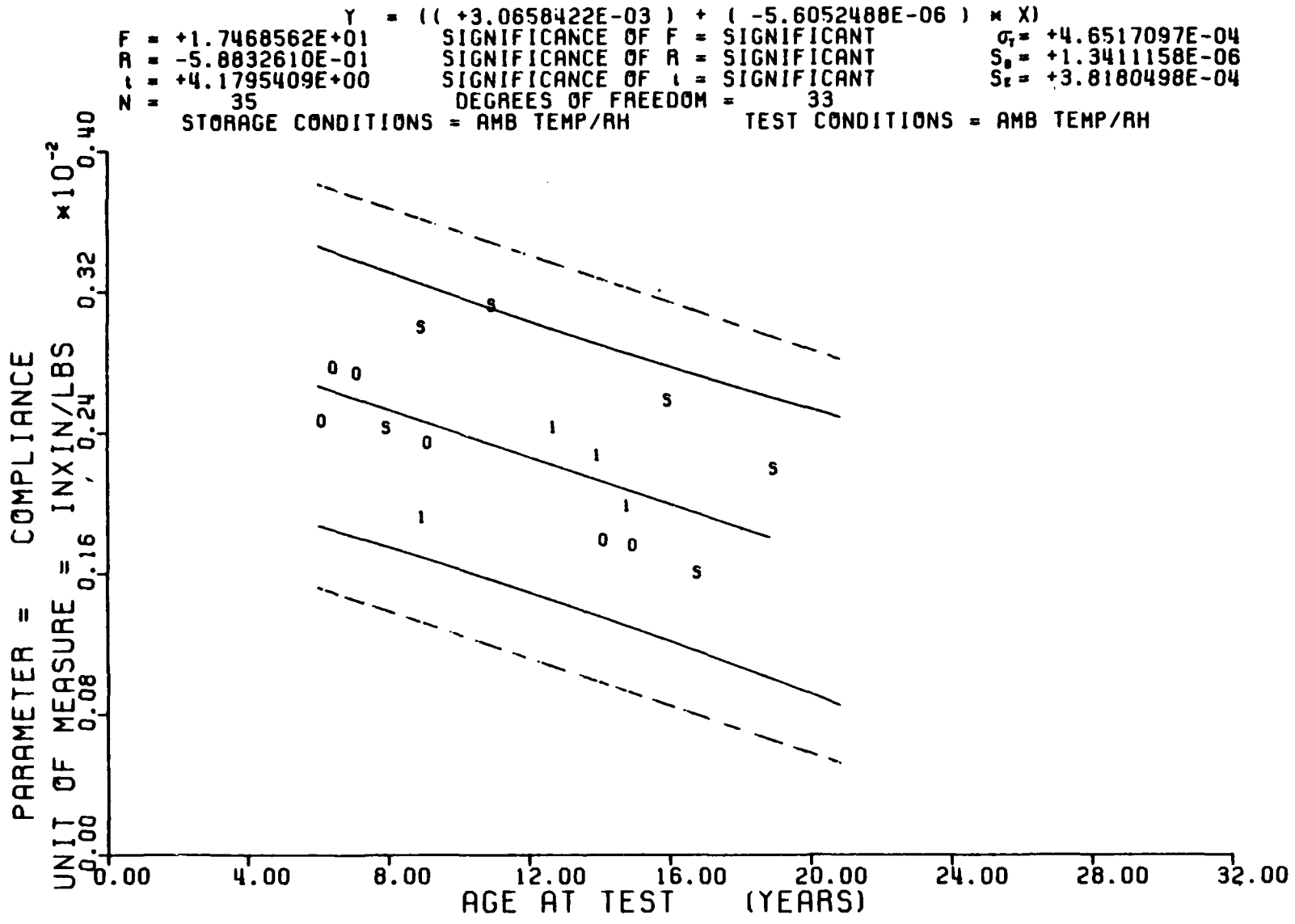
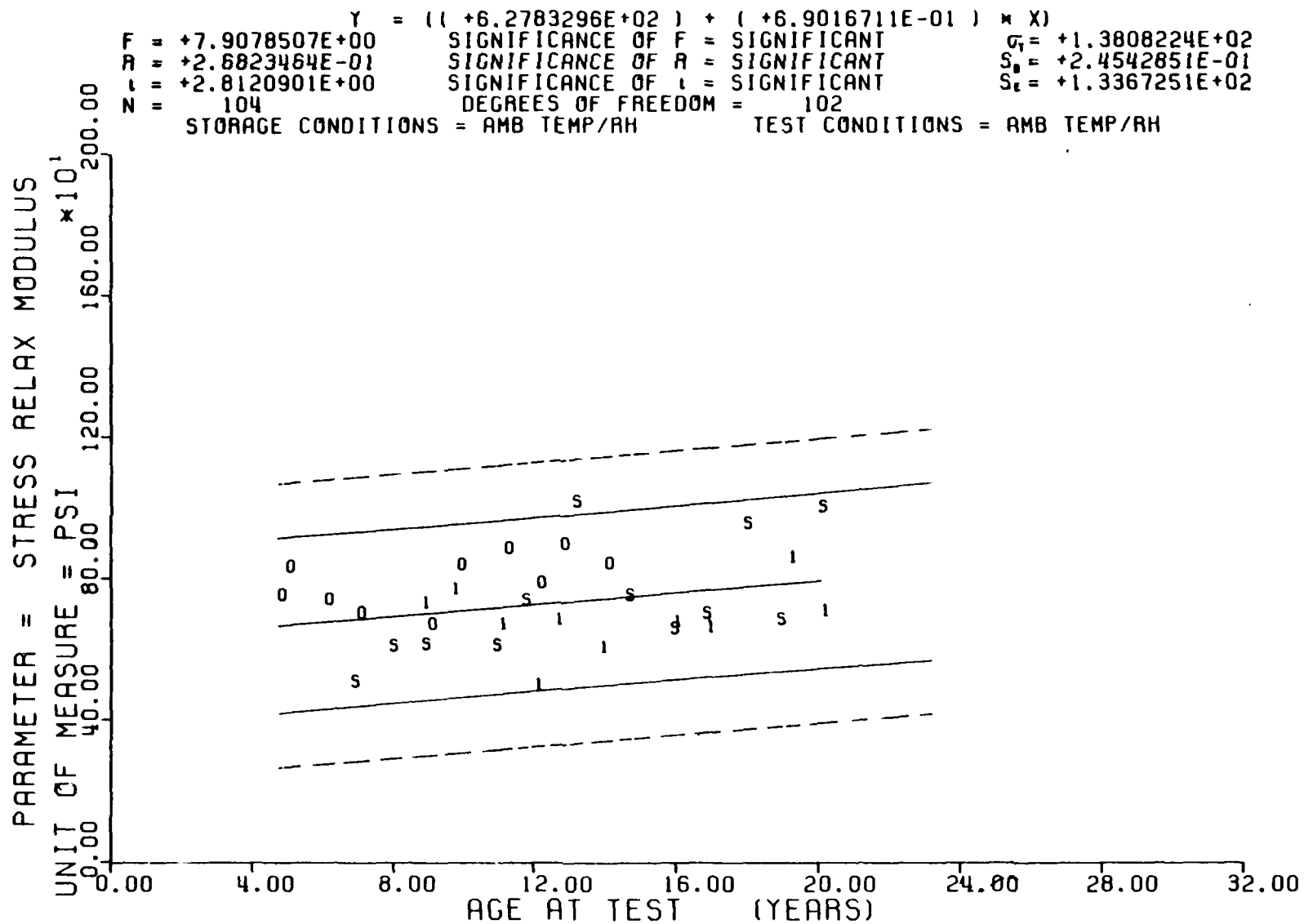
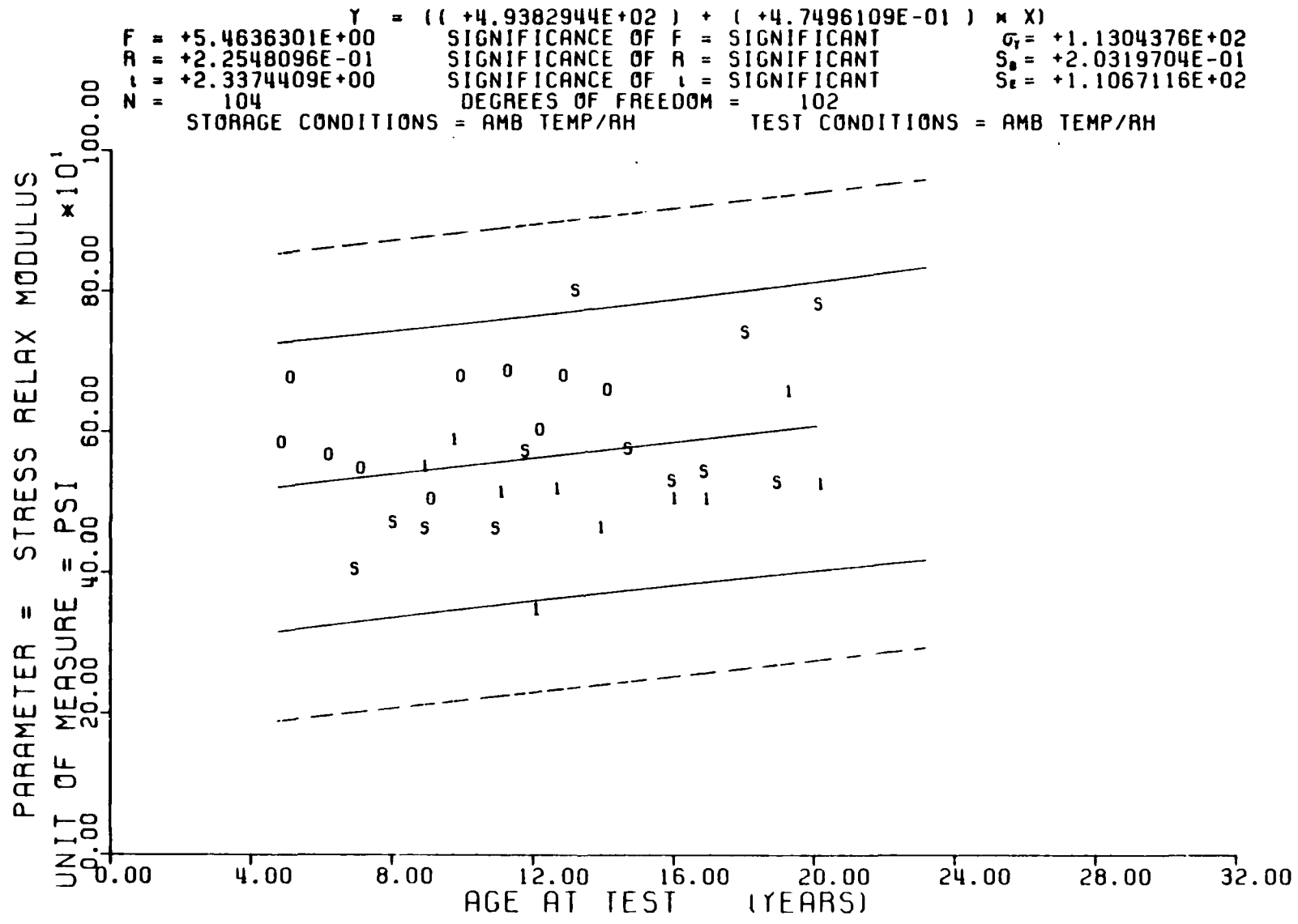

Y = ((+3.0658422E-03) + (-5.6052488E-06) * X)
F = +1.7468562E+01 SIGNIFICANCE OF F = SIGNIFICANT σT = +4.6517097E-04
R = -5.8832610E-01 SIGNIFICANCE OF R = SIGNIFICANT Sb = +1.3411158E-06
t = +4.1795409E+00 SIGNIFICANCE OF t = SIGNIFICANT Se = +3.8180498E-04
N = 35 DEGREES OF FREEDOM = 33
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = COMPLIANCE
UNIT OF MEASURE = INXIN/LBS *10-2
0.00
0.08
0.16
0.24
0.32
0.40
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
DISSECTED MOTOR TP-H1011,CREEP 10 LB LOAD,COMPLIANCE AT 10,000 SEC.

Figure 29



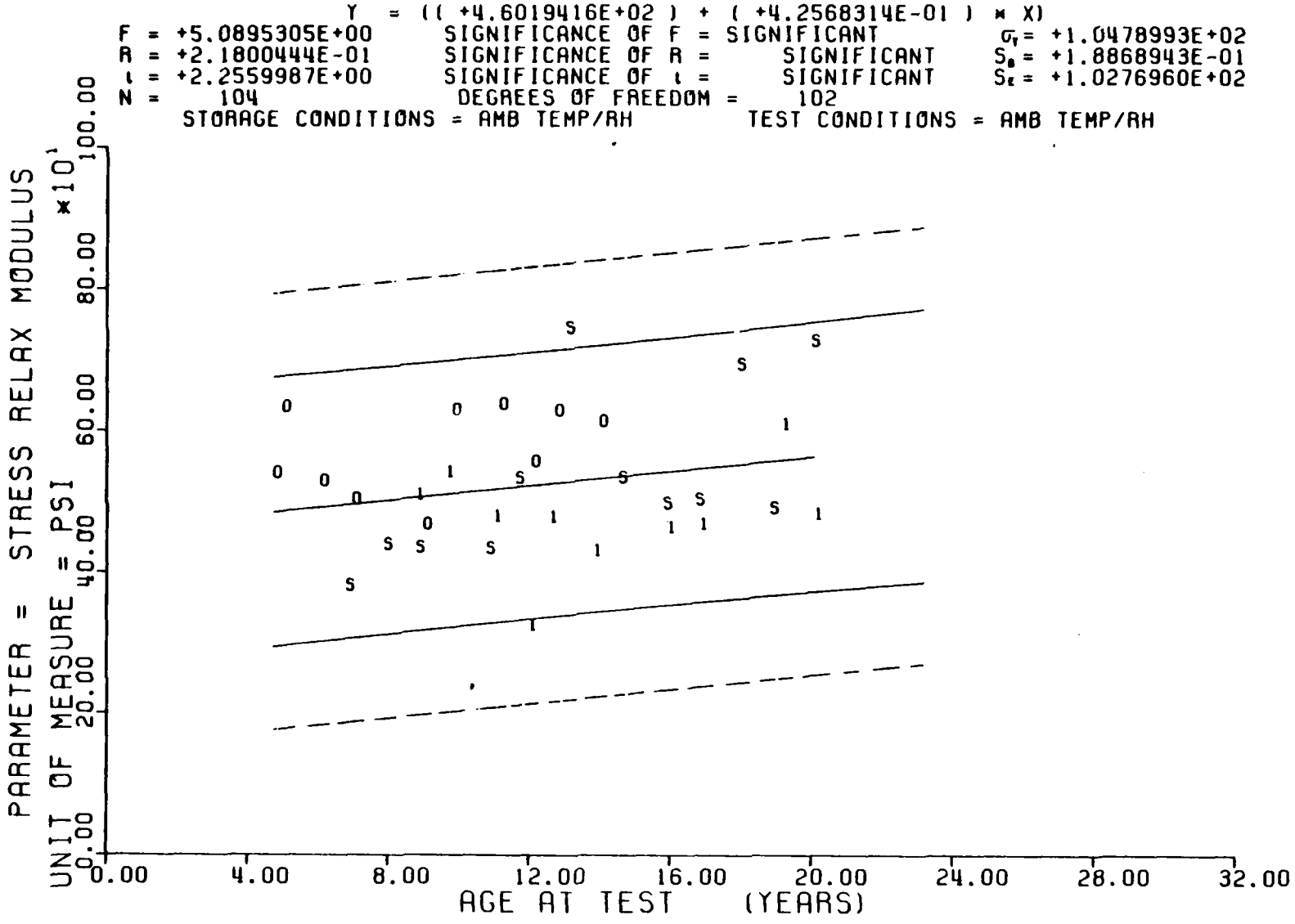
TP-H1011 DISSECTED MTRS, STRESS RELAXATION MODULUS, 3 PERCENT STRAIN, 10 SEC

Figure 30



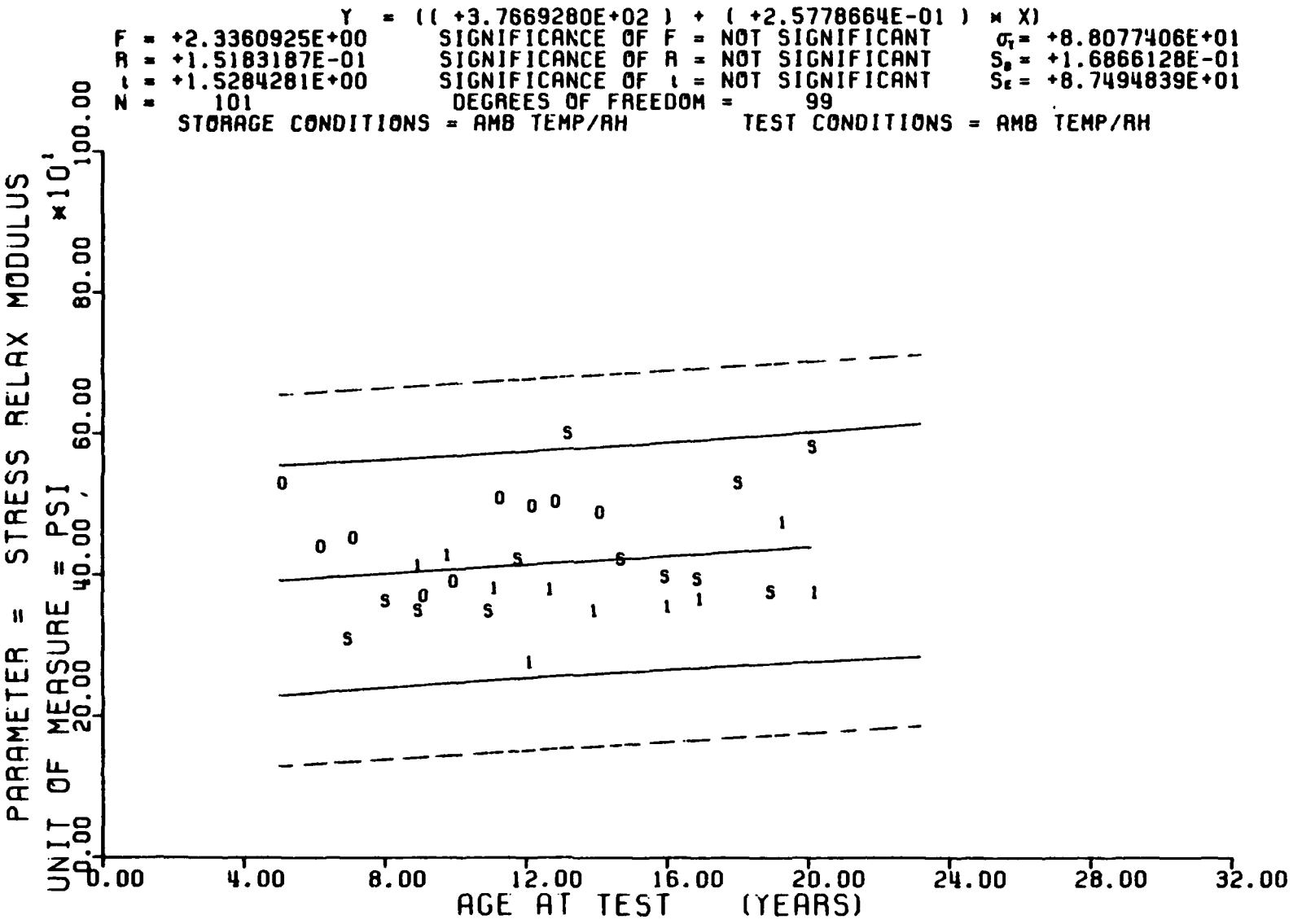
TP-H1011 DISSECTED MTRS, STRESS RELAXATION MODULUS, 3 PERCENT STRAIN, 50 SEC

Figure 31



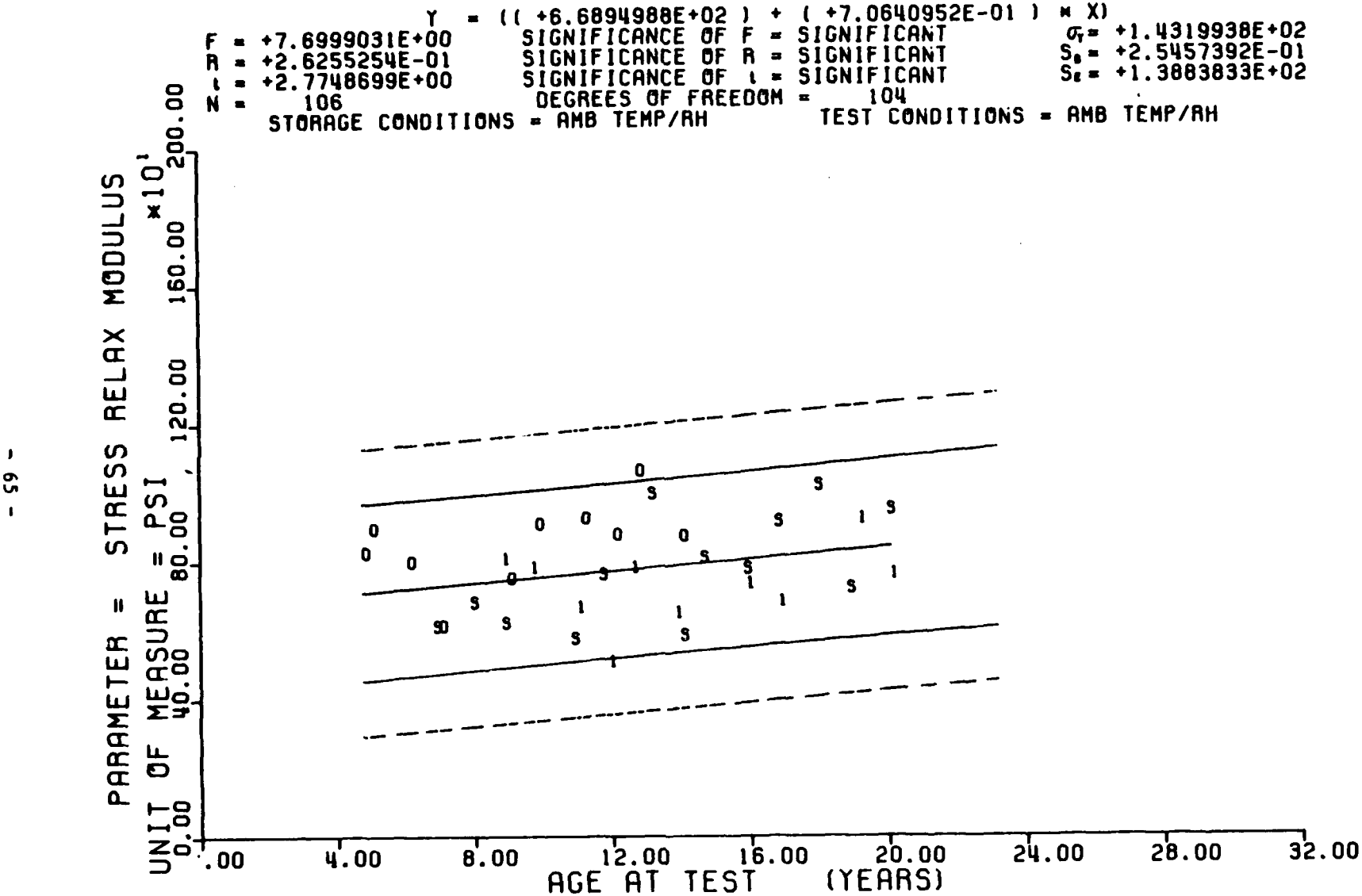
TP-H1011 DISSECTED MTRS, STRESS RELAXATION MODULUS, 3 PERCENT STRAIN, 100 SEC

Figure 32



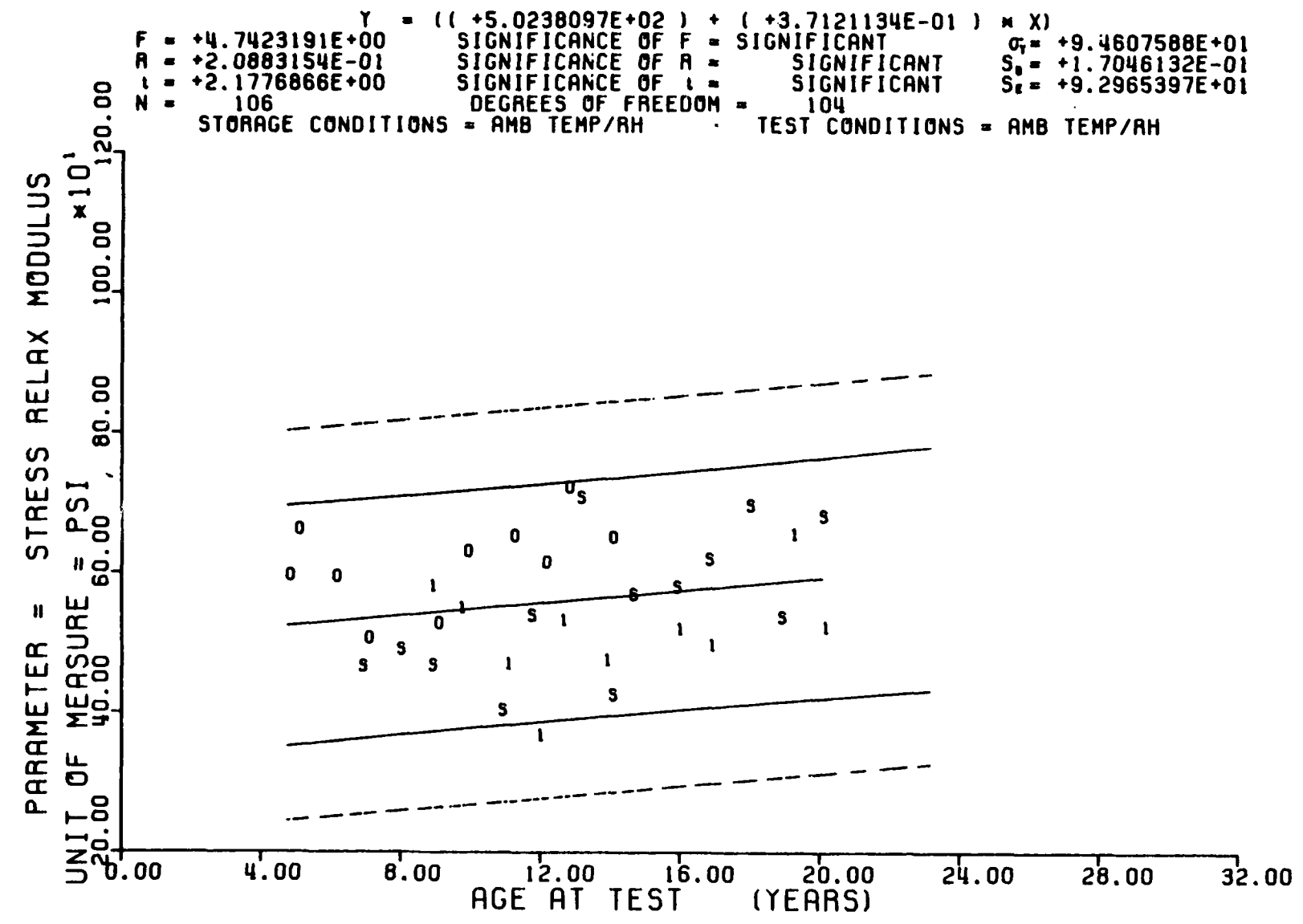
TP-H1011 DISSECTED MTRS, STRESS RELAXATION MODULUS, 3 PERCENT STRAIN, 1000 SEC

Figure 33



TP-H1011 DISSECTED MTRS, STRESS RELAXATION MODULUS, 5 PERCENT STRAIN, 10 SEC

Figure 34



TP-H1011 DISSECTED MTRS, STRESS RELAXATION MODULUS, 5 PERCENT STRAIN, 50 SEC

Figure 35

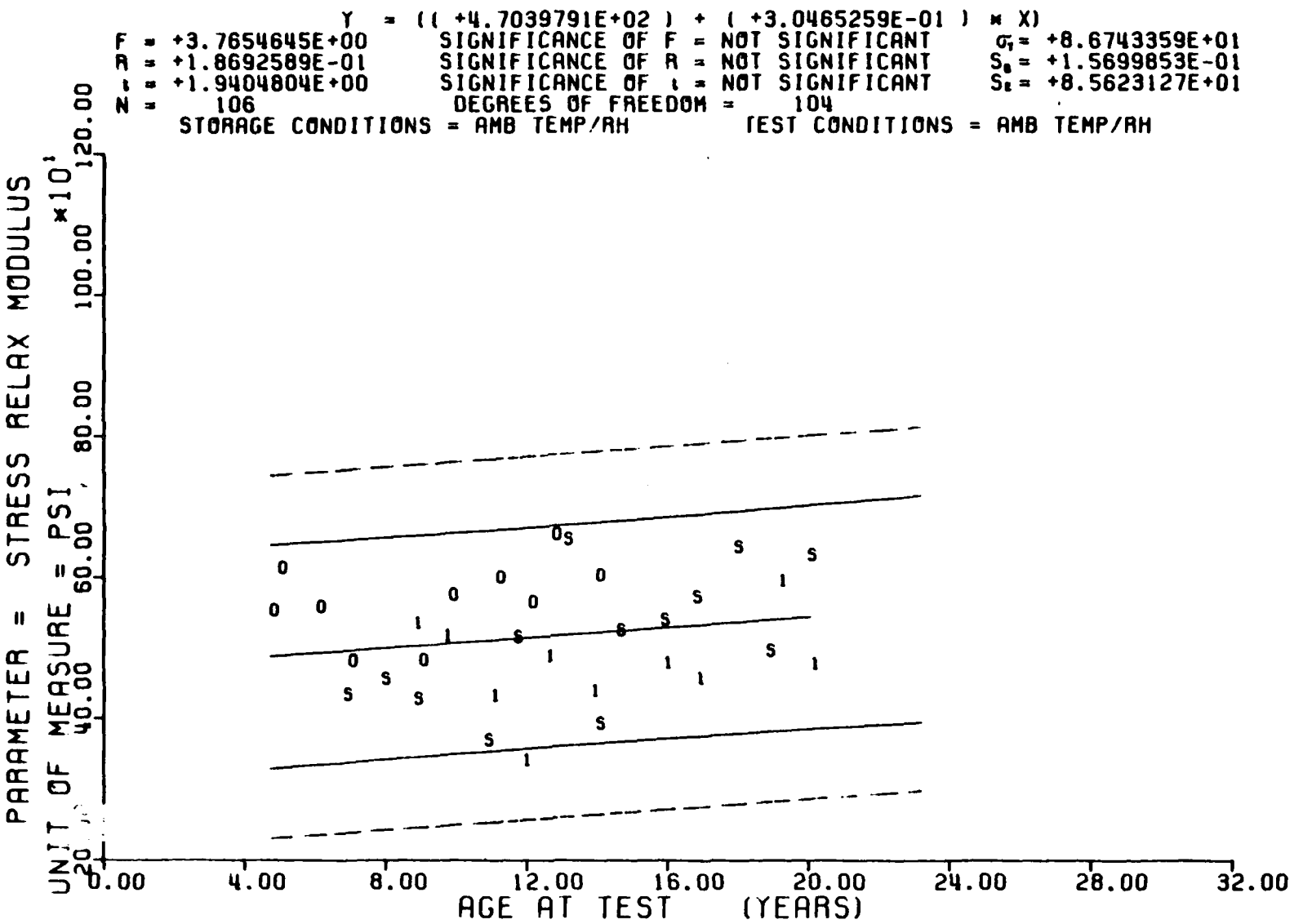
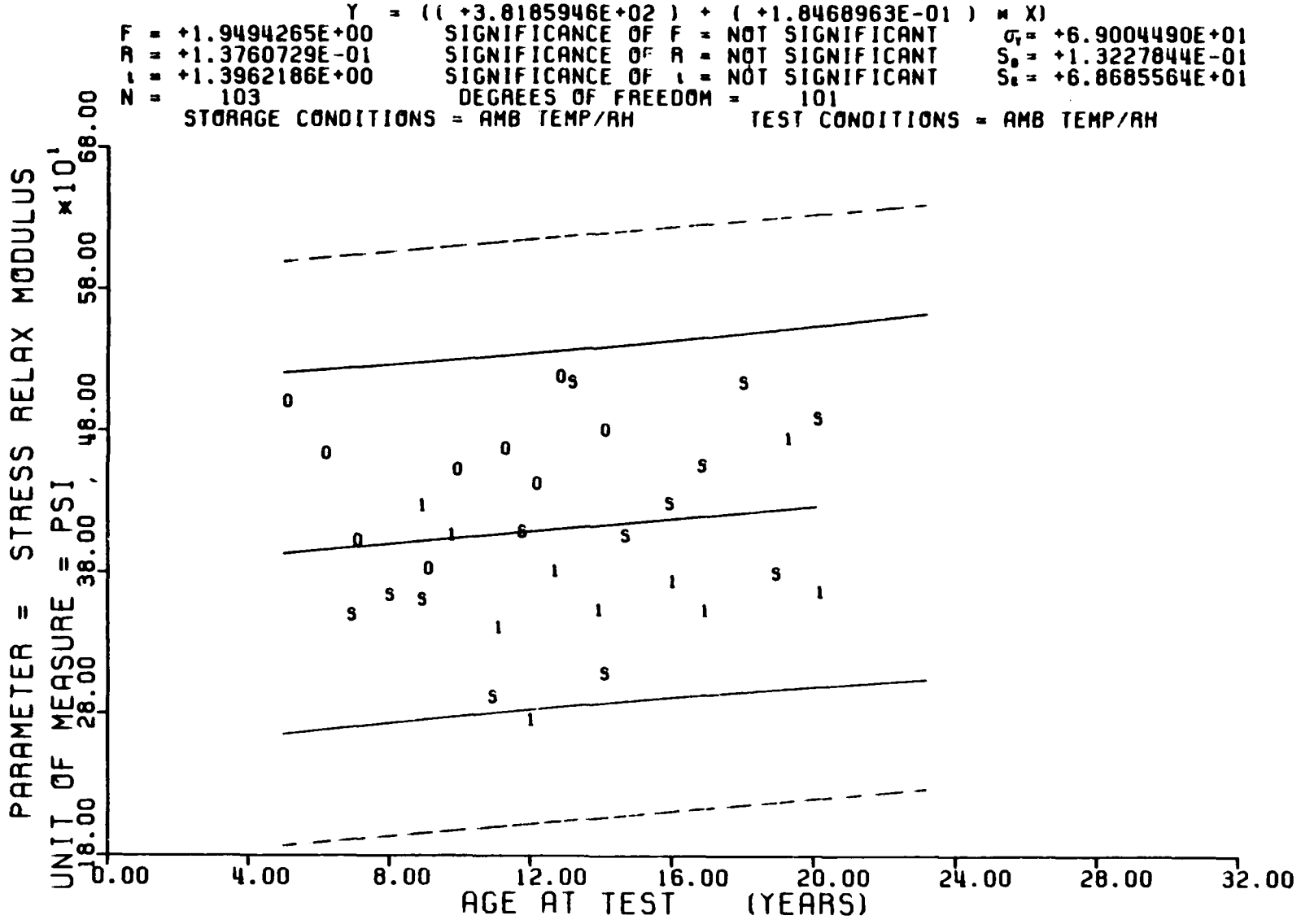
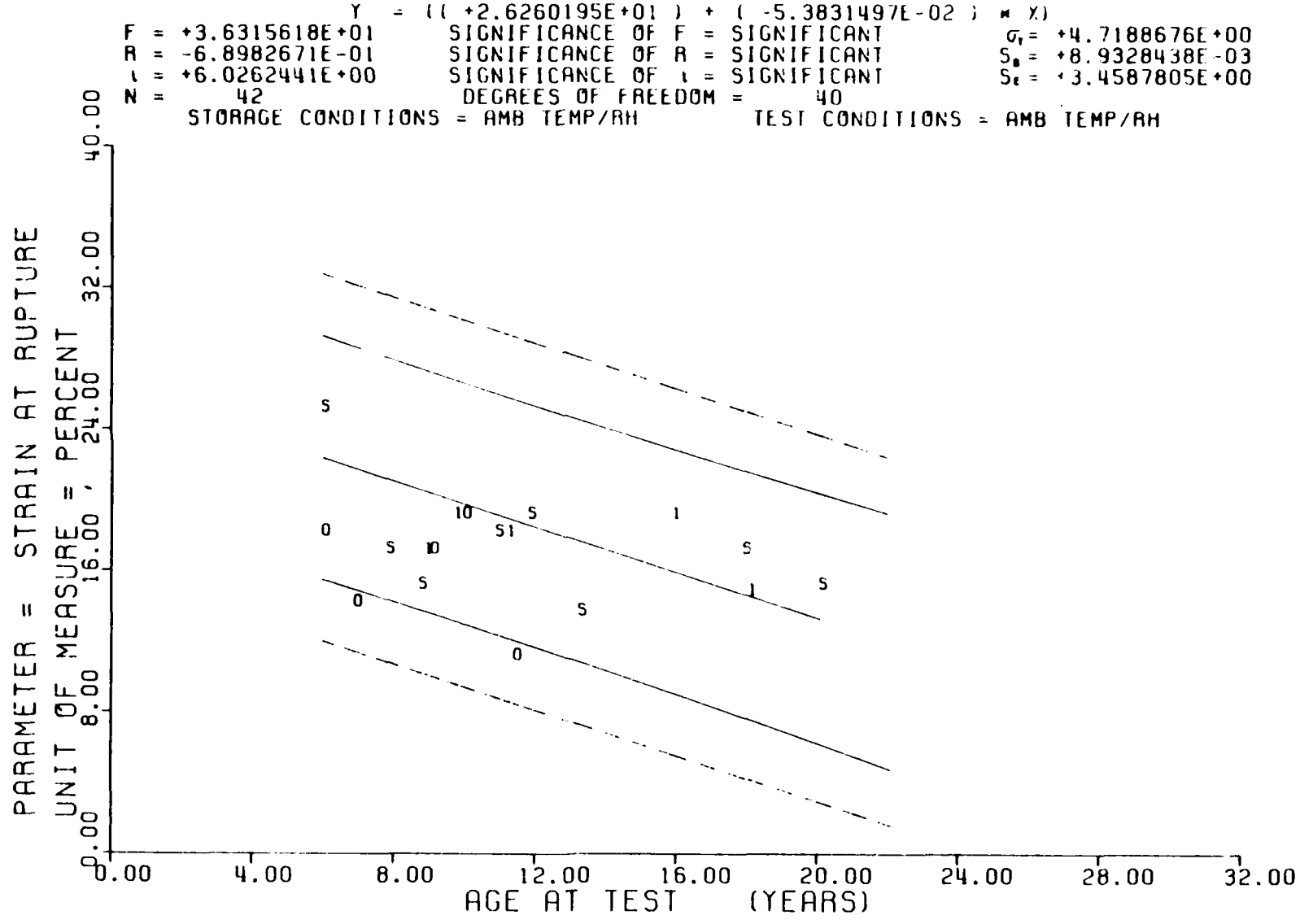

Y = ((+4.7039791E+02) + (+3.0465259E-01) * X)
F = +3.7654645E+00 SIGNIFICANCE OF F = NOT SIGNIFICANT σi = +8.6743359E+01
R = +1.8692589E-01 SIGNIFICANCE OF R = NOT SIGNIFICANT Sa = +1.5699853E-01
t = +1.9404804E+00 SIGNIFICANCE OF t = NOT SIGNIFICANT St = +8.5623127E+01
N = 106 DEGREES OF FREEDOM = 104
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRESS RELAX MODULUS
UNIT OF MEASURE = PSI *10¹
120.00
100.00
80.00
60.00
40.00
20
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
TP-M1011 DISSECTED MTRS, STRESS RELAXATION MODULUS, 5 PERCENT STRAIN, 100 SEC

Figure 36



TP-H1011 DISSECTED MTRS, STRESS RELAXATION MODULUS, 5 PERCENT STRAIN, 1000 SEC

Figure 37



STAGE 1 OSSCTD MTRS, CONSTANT STRAIN, STRAIN 0.1 INIT AND 0.01 EVERY 48 HRS

Figure 38

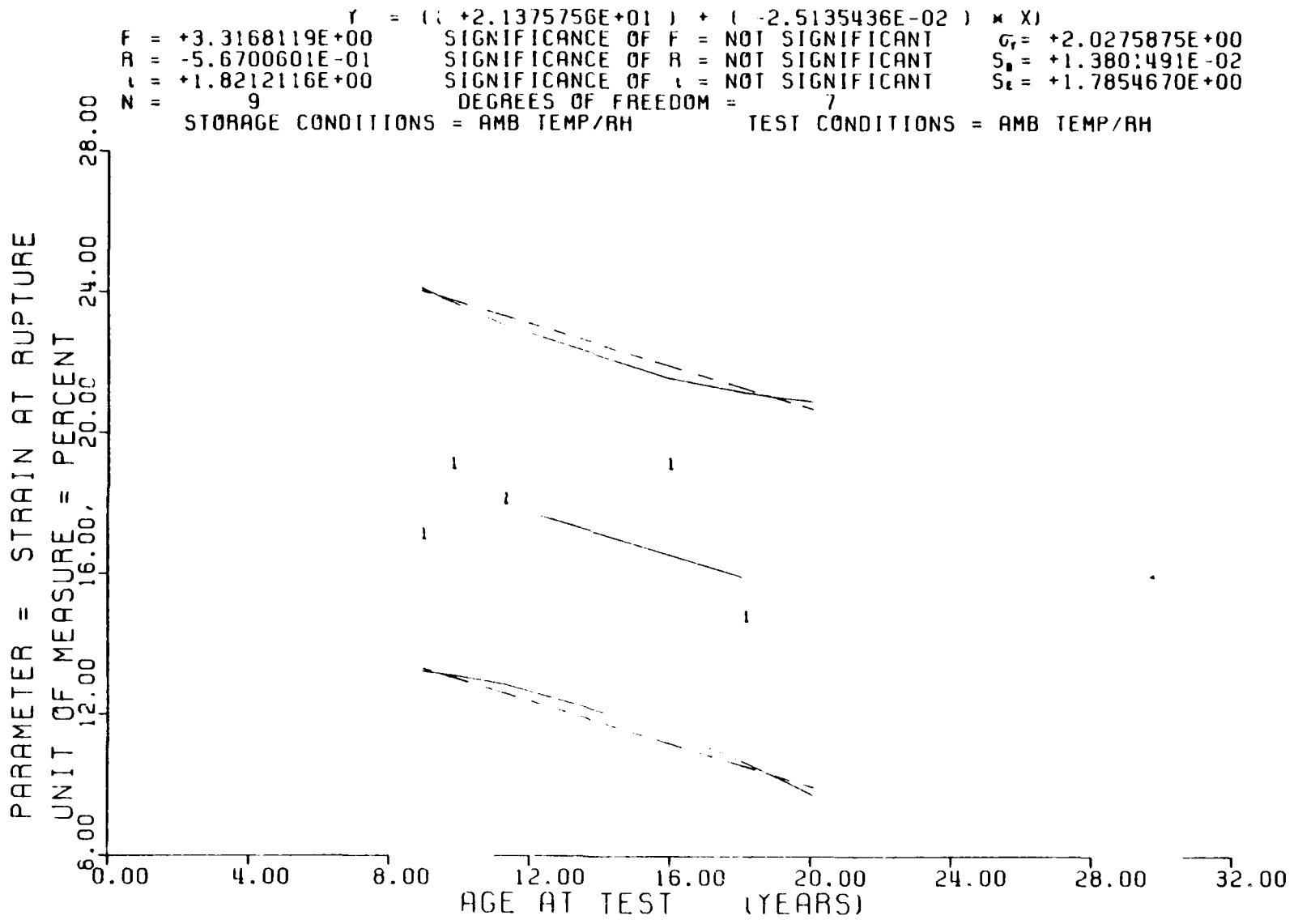
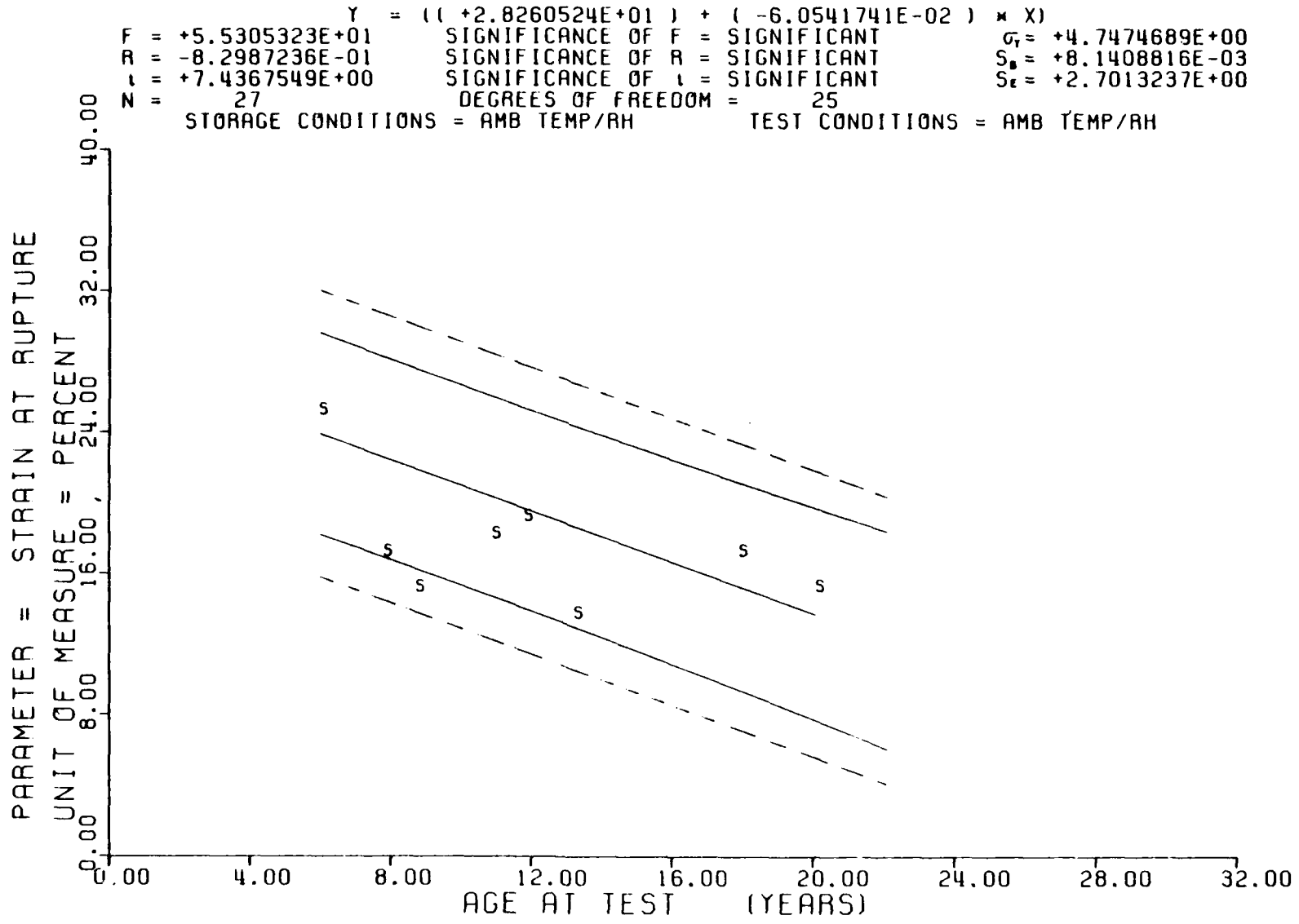

Y = (+2.137575GE+01) + (-2.5135436E-02) × X)
F = +3.3168119E+00 SIGNIFICANCE OF F = NOT SIGNIFICANT σr = +2.0275875E+00
R = -5.6700601E-01 SIGNIFICANCE OF R = NOT SIGNIFICANT Sb = +1.3801491E-02
t = +1.8212116E+00 SIGNIFICANCE OF t = NOT SIGNIFICANT St = +1.7854670E+00
N = 9 DEGREES OF FREEDOM = 7
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT RUPTURE
UNIT OF MEASURE = PERCENT
28.00
24.00
20.00
16.00
12.00
8.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,DSSCTO MTR=0012199,CONTANT STRAIN,STRAIN 0.1 INIT & 0.01 EVERY 48 HRS.

Figure 38A



STAGE 1,DSSCTD MTR=STM-012,CONTANT STRAIN,STRAIN 0.1 INIT & 0.01 EVERY 48 HRS.

Figure 38B

Y = (+7.0971554E+01) + (-2.2473799E-02) * X)

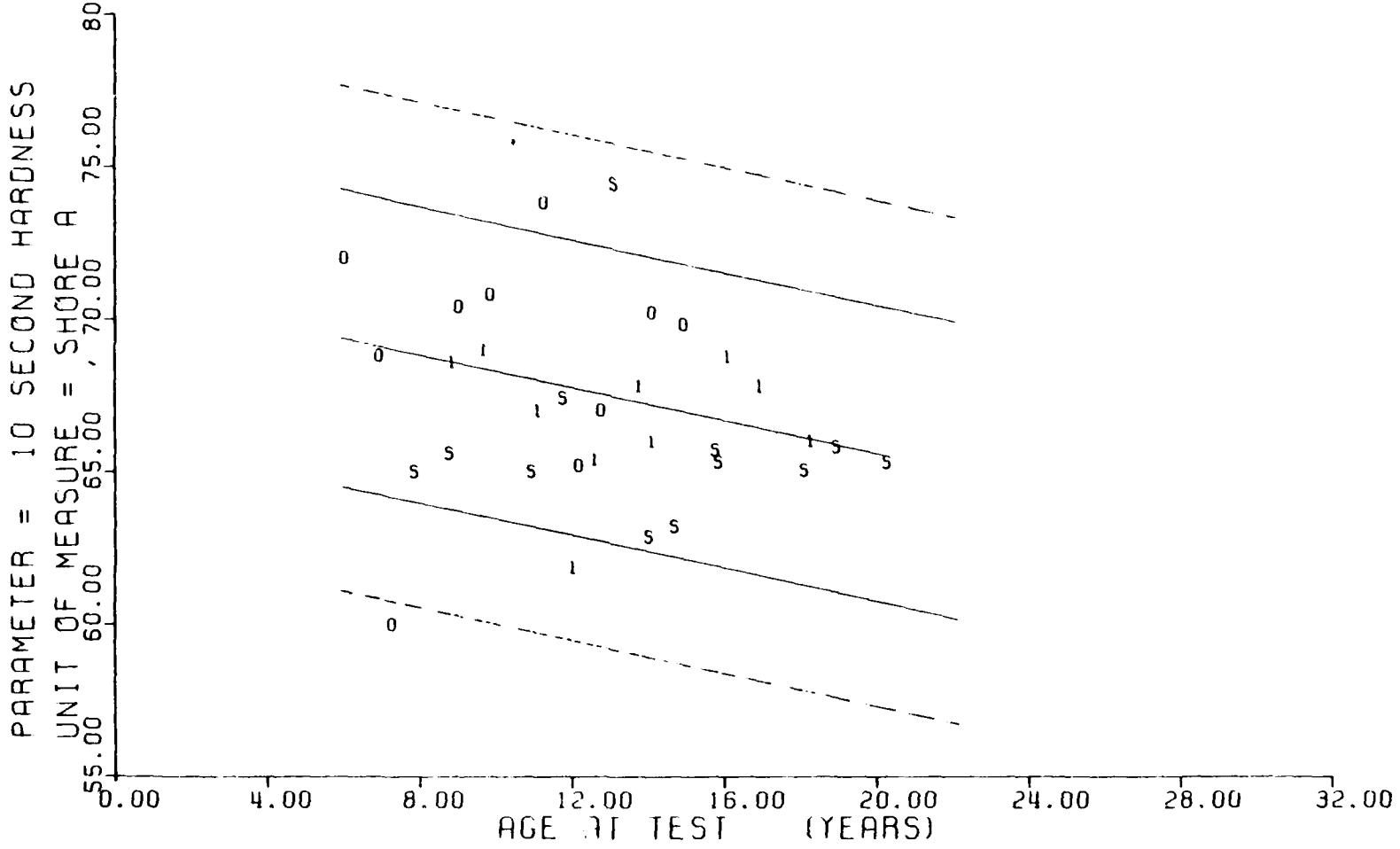
F = +2.7910455E+01 SIGNIFICANCE OF F = SIGNIFICANT σ_r = +2.8882287E+00

R = -3.0107260E-01 SIGNIFICANCE OF R = SIGNIFICANT S_b = +4.2539564E-03

t = +5.2830346E+00 SIGNIFICANCE OF t = SIGNIFICANT S_t = +2.7591322E+00

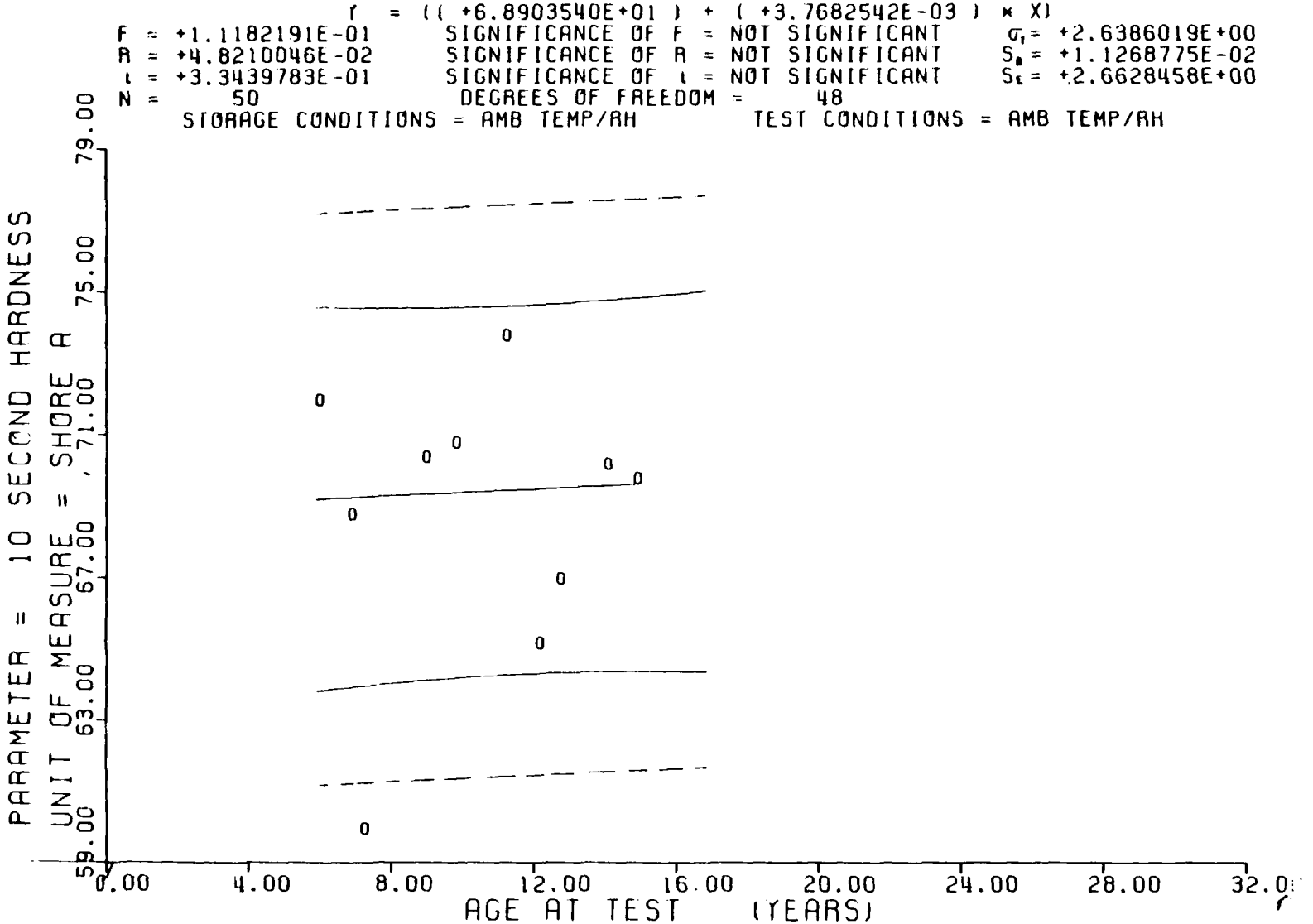
N = 282 DEGREES OF FREEDOM = 280

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



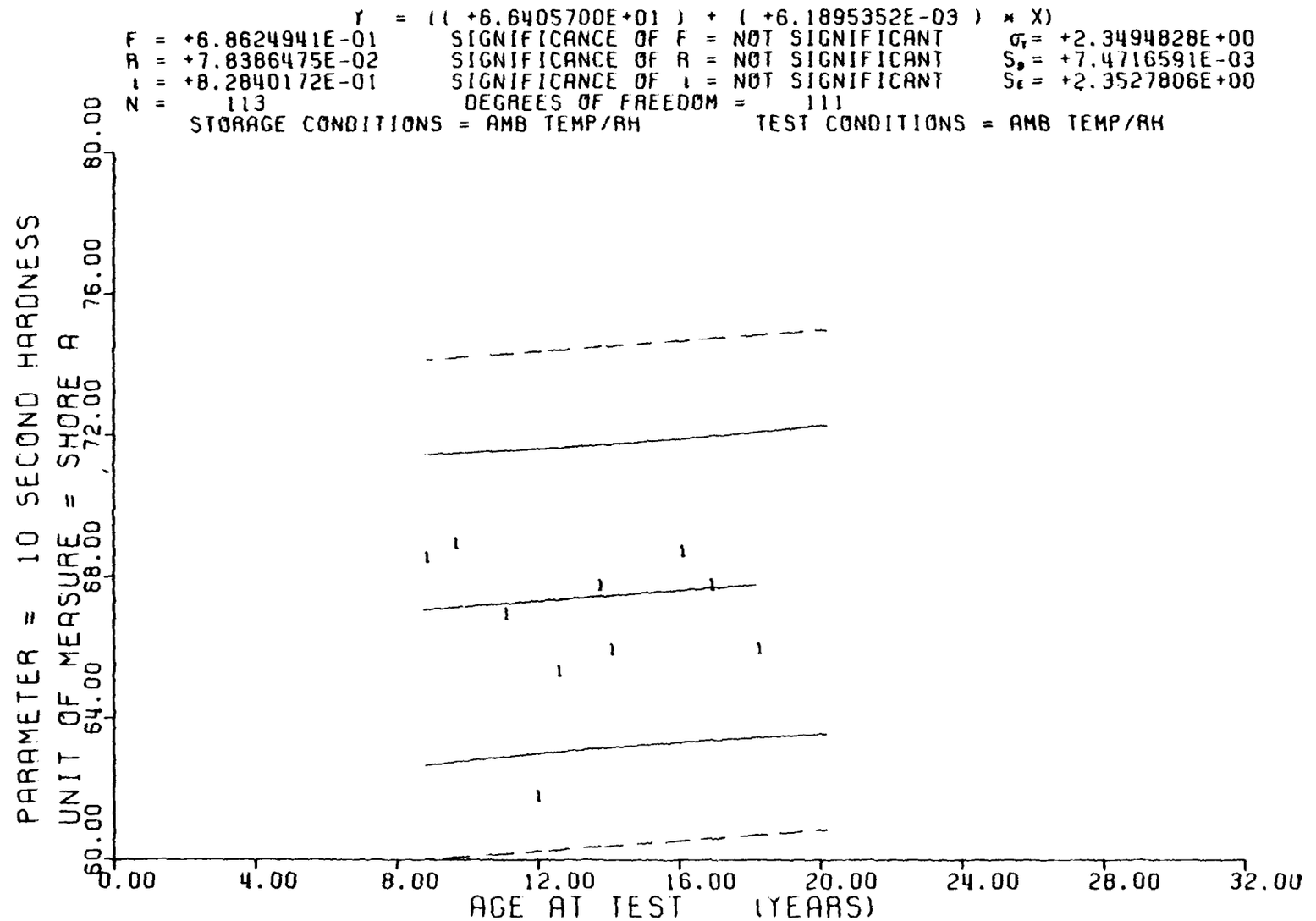
STAGE 1 DISCTED MOTORS= (0) 12099, (1) 12199, (S) STM012, HARDNESS, SHORE A 10-SEC.

Figure 39



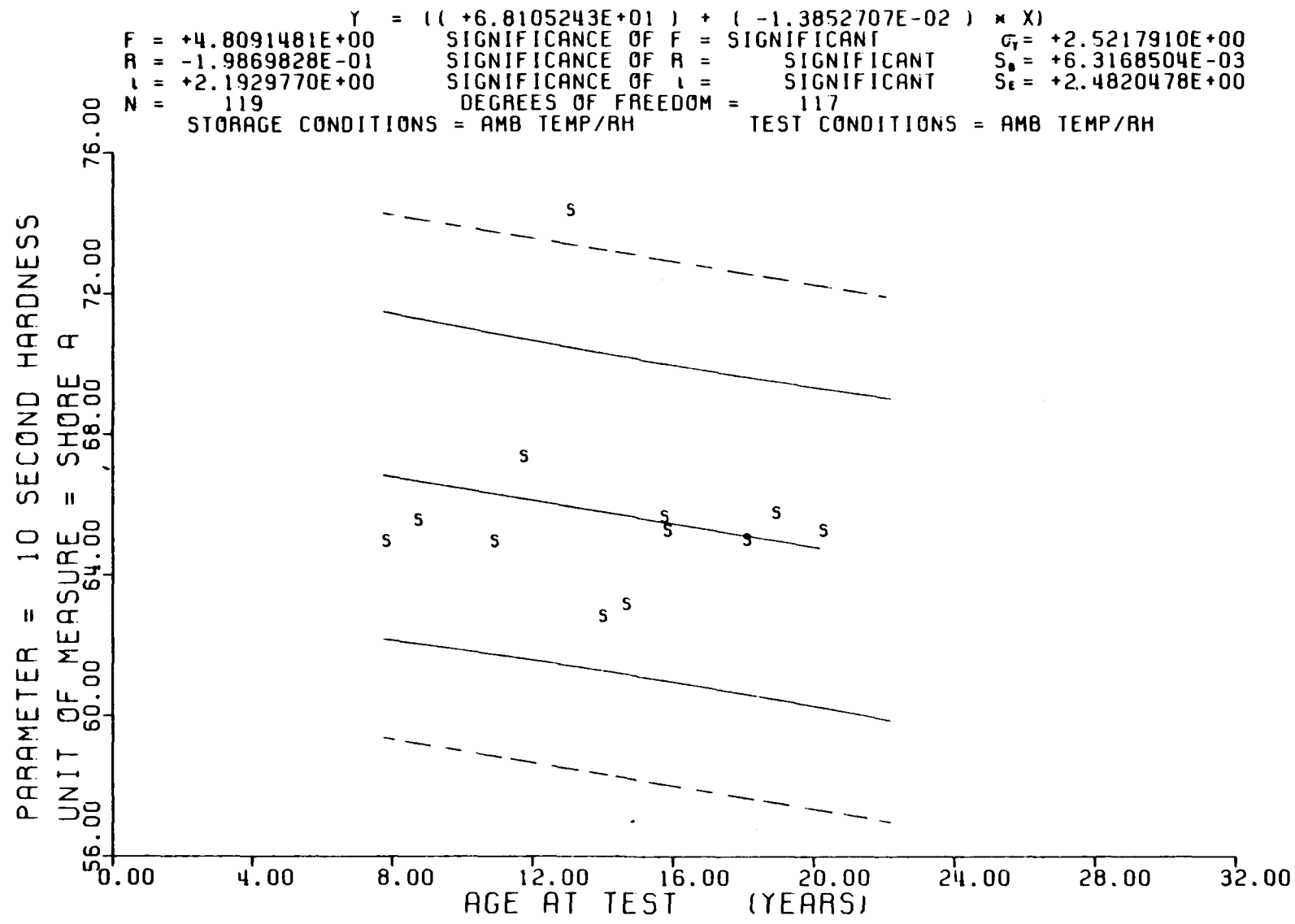
STAGE 1, DISSECTED MOTOR=(0)0012099, SHORE-A HARDNESS, 10 SECOND.

Figure 39A



STAGE 1, DISSECTED MOTOR=(1)0012199, SHORE-A HARDNESS, 10 SECOND.

Figure 39B



STAGE 1, DISSECTED MOTOR=(S)STM-012, SHORE-A HARDNESS, 10 SECOND.

Figure 39C

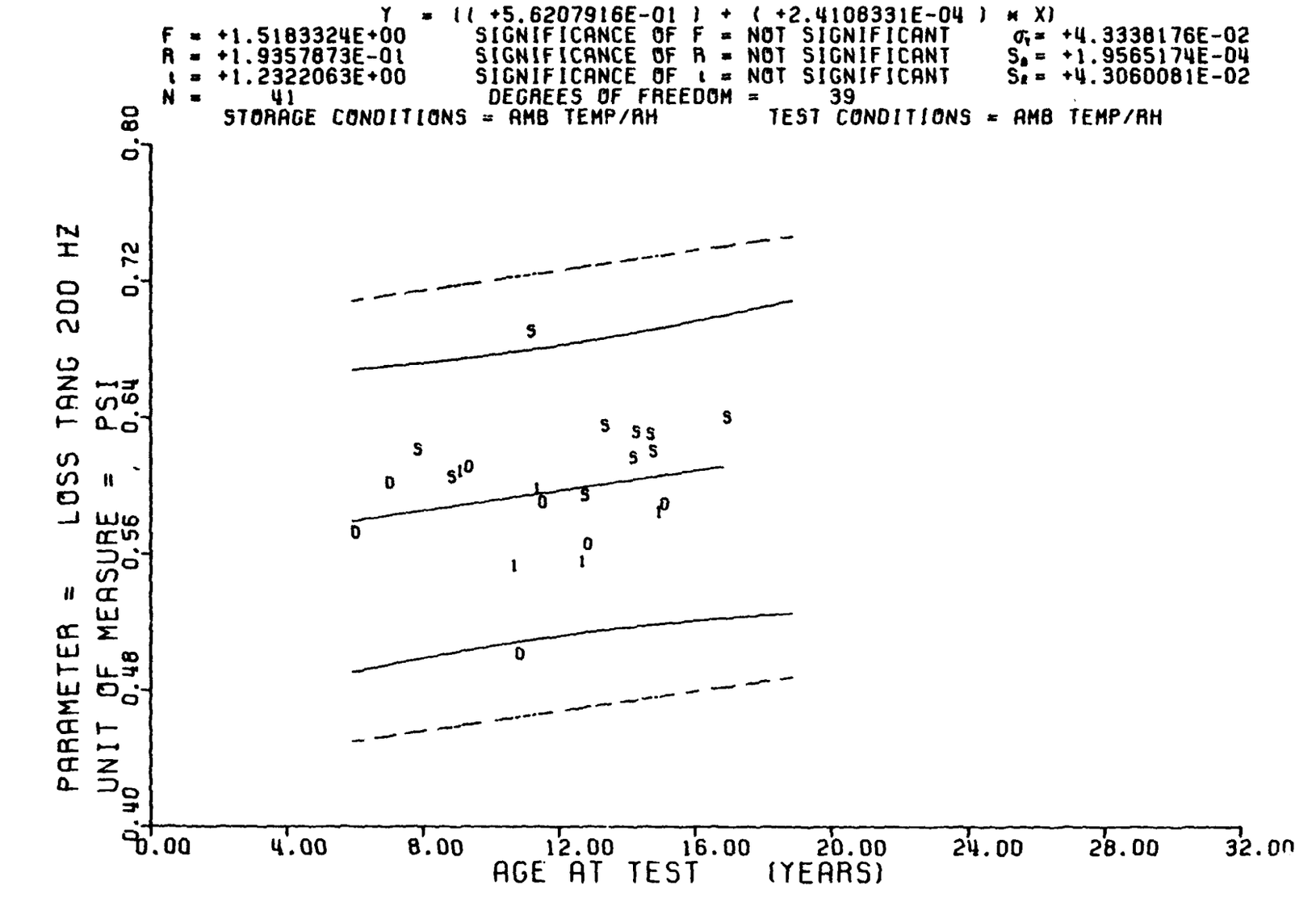
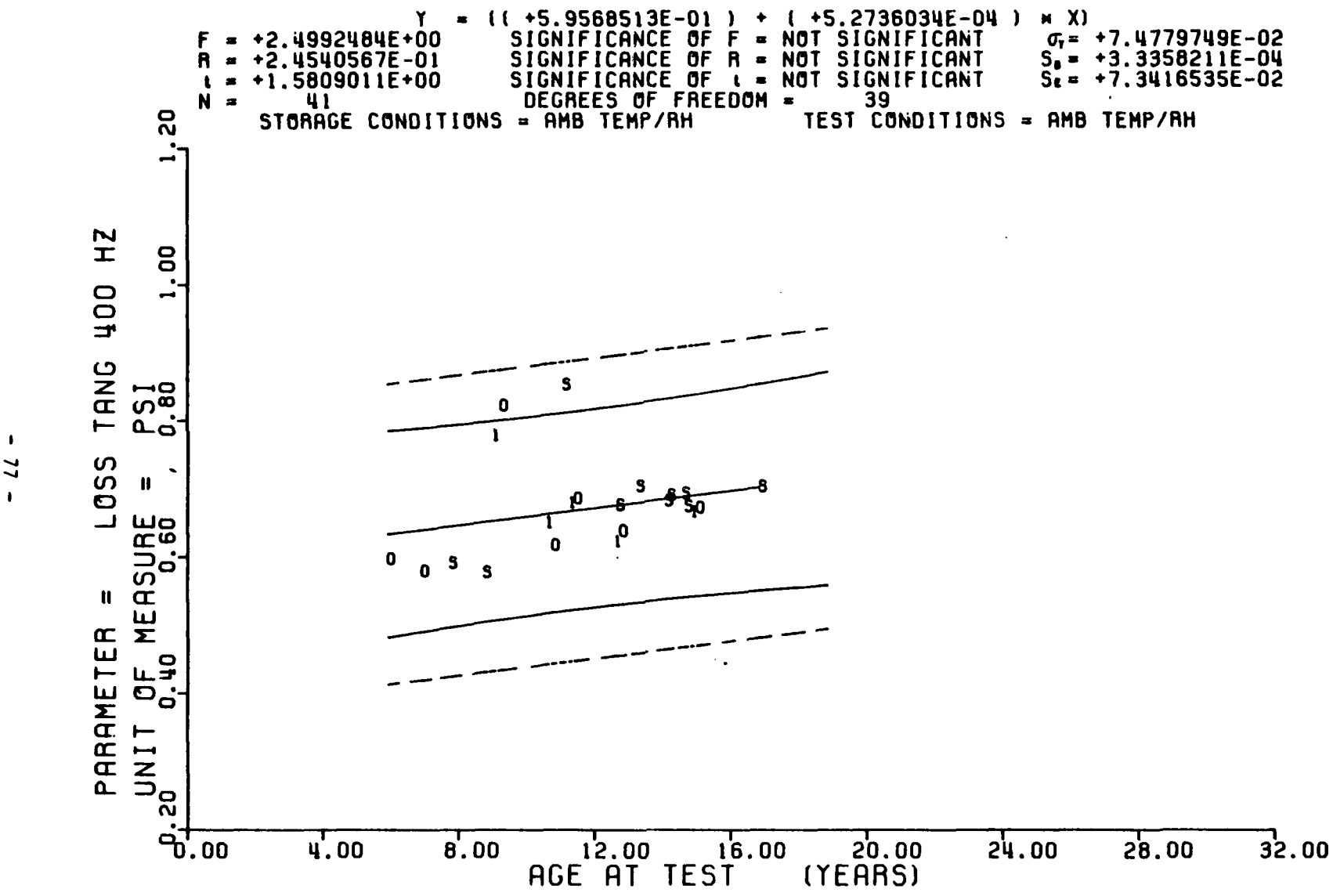
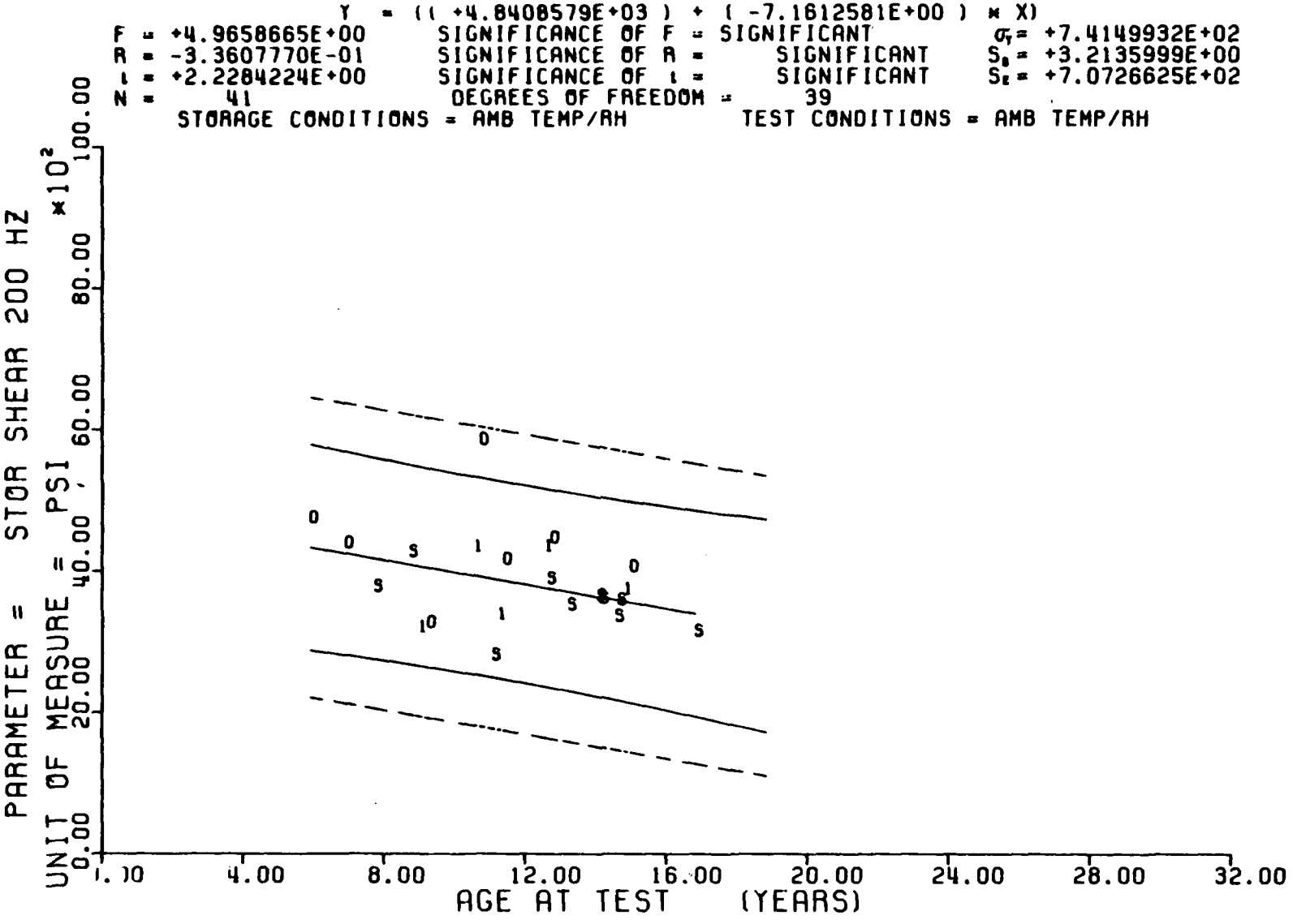

Y = ((+5.6207916E-01) + (+2.4108331E-04) * X)
F = +1.5183324E+00 SIGNIFICANCE OF F = NOT SIGNIFICANT σ = +4.3338176E-02
R = +1.9357873E-01 SIGNIFICANCE OF R = NOT SIGNIFICANT S_b = +1.9565174E-04
t = +1.2322063E+00 SIGNIFICANCE OF t = NOT SIGNIFICANT S_ε = +4.3060081E-02
N = 41 DEGREES OF FREEDOM = 39
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = LOSS TANG 200 HZ
UNIT OF MEASURE = PSI
0.80
0.72
0.64
0.56
0.48
0.40
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE I DISSECTED MOTORS,DYNAMIC RESPONSE,CENTER-WT 70 GM,LOSS TANG AT 200 HZ

Figure 40



STAGE I DISSECTED MOTORS, DYNAMIC RESPONSE, CENTER-WT 70 GM, LOSS TANG AT 400 HZ

Figure 41



STAGE I DISSECTED MOTORS, DYNAMIC RESPONSE, CENTER-WT 70 GM, STOR SHEAR AT 200 HZ

Figure 42

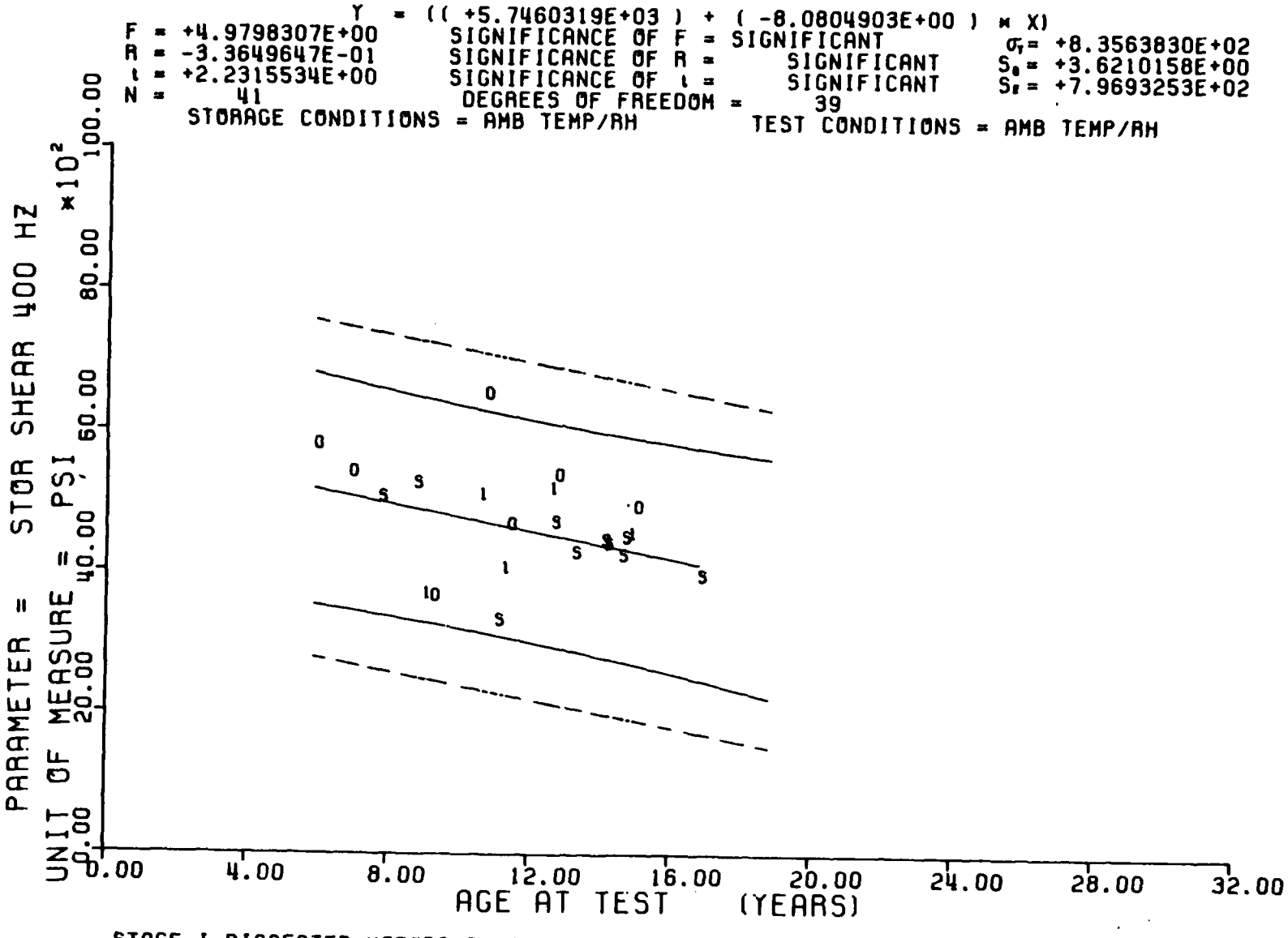
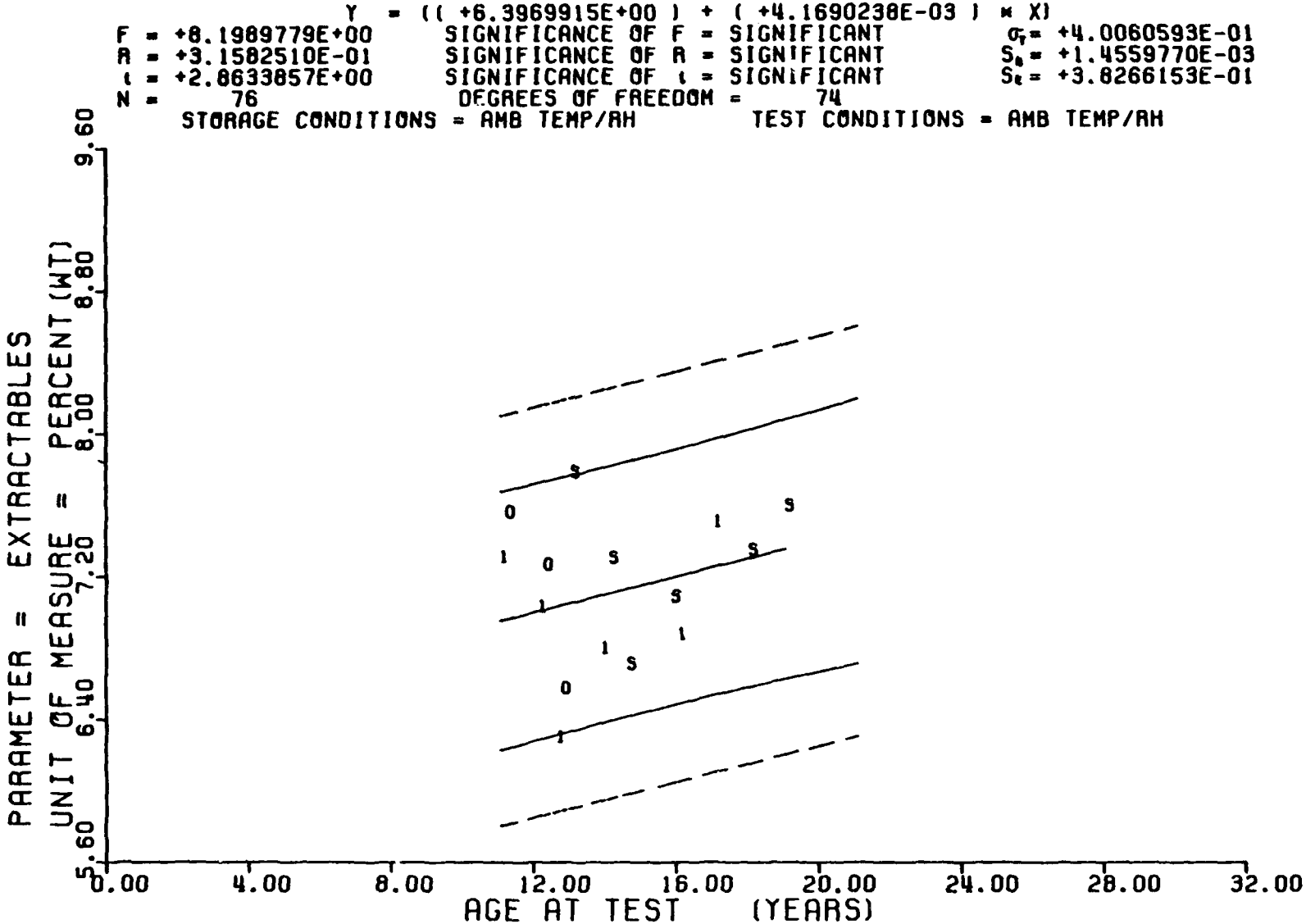

Y = ((+5.7460319E+03) + (-8.0804903E+00) * X)
F = +4.9798307E+00 SIGNIFICANCE OF F = SIGNIFICANT σ1 = +8.3563830E+02
R = -3.3649647E-01 SIGNIFICANCE OF R = SIGNIFICANT Se = +3.6210158E+00
t = +2.2315534E+00 SIGNIFICANCE OF t = SIGNIFICANT Sr = +7.9693253E+02
N = 41 DEGREES OF FREEDOM = 39
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STOR SHEAR 400 HZ
UNIT OF MEASURE = PSI *10²
100.00
80.00
60.00
40.00
20.00
0.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE I DISSECTED MOTORS, DYNAMIC RESPONSE, CENTER-WT 70 GM, STOR SHEAR AT 400 HZ

Figure 43



DISSECTED MTR, STAGE 1, TP-H1011, SOL GEL, PERCENT EXTRACTABLES

Figure 44

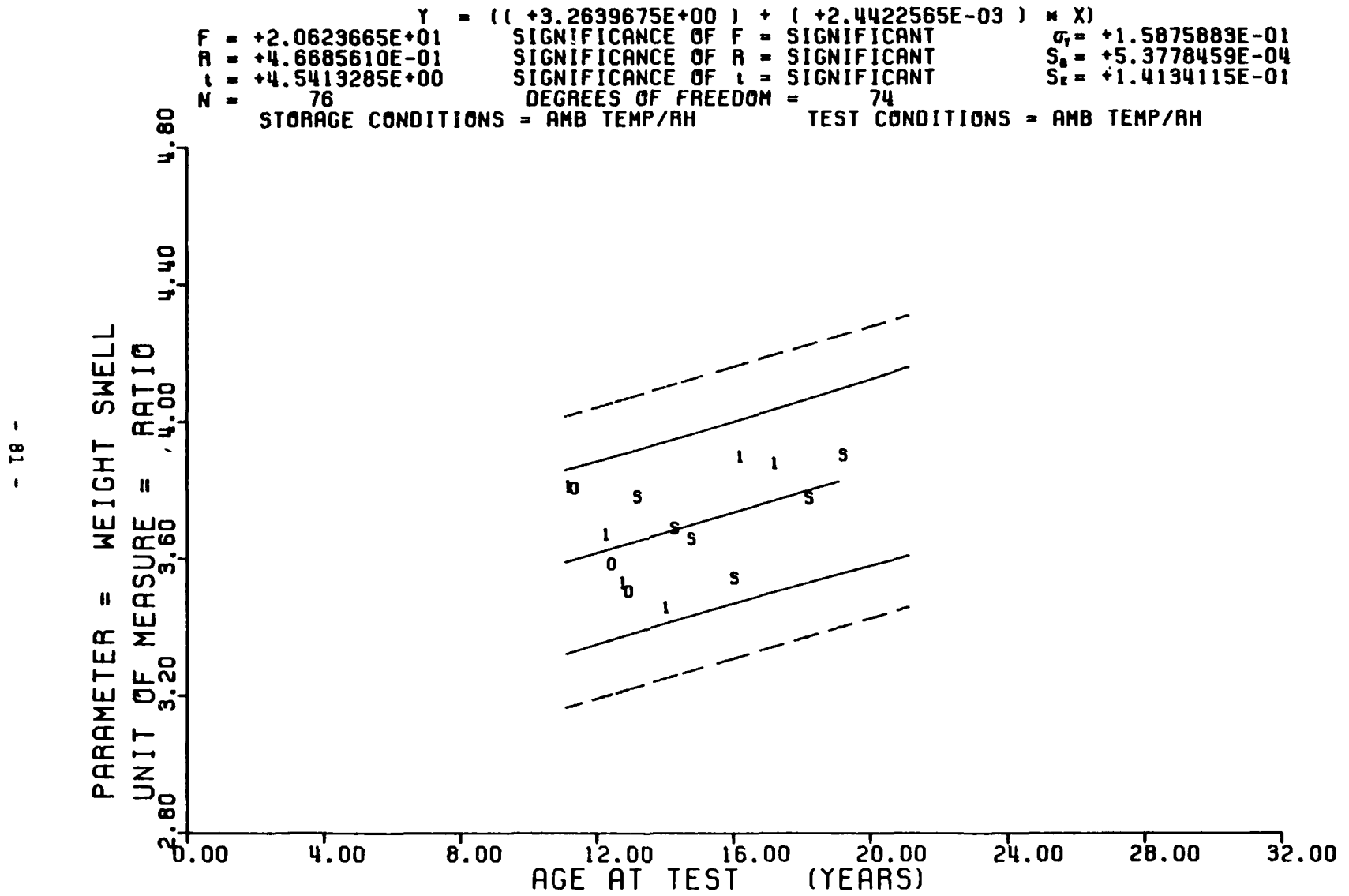

Y = ((+3.2639675E+00) + (+2.4422565E-03) * X)
F = +2.0623665E+01 SIGNIFICANCE OF F = SIGNIFICANT
R = +4.6685610E-01 SIGNIFICANCE OF R = SIGNIFICANT
t = +4.5413285E+00 SIGNIFICANCE OF t = SIGNIFICANT
N = 76 DEGREES OF FREEDOM = 74
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = WEIGHT SWELL
UNIT OF MEASURE = RATIO
2.80
3.20
3.60
4.00
4.40
4.80
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
DISSECTED MTR, STAGE 1, TP-H1011, SOL GEL, WT SWELL RATIO

Figure 45

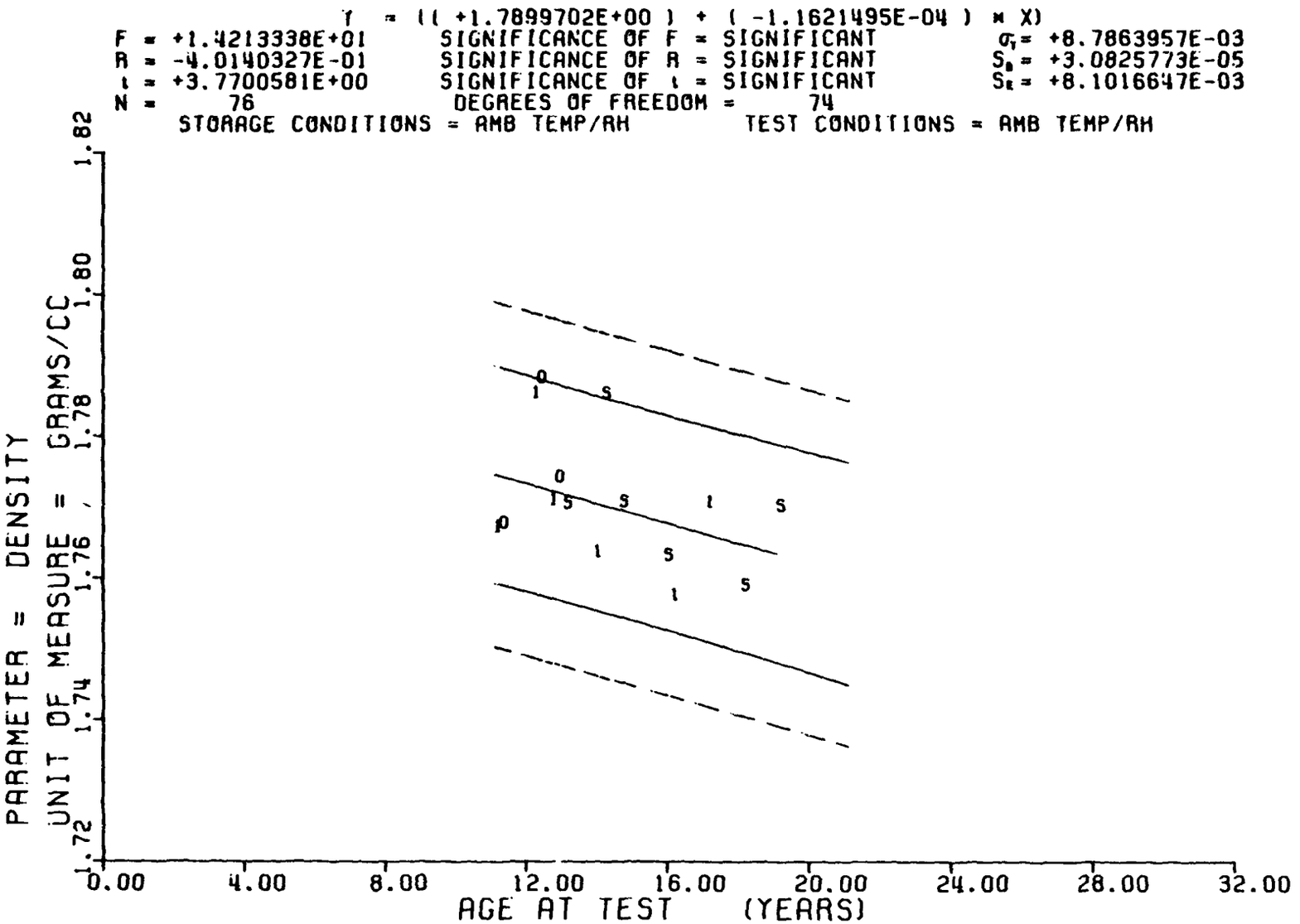
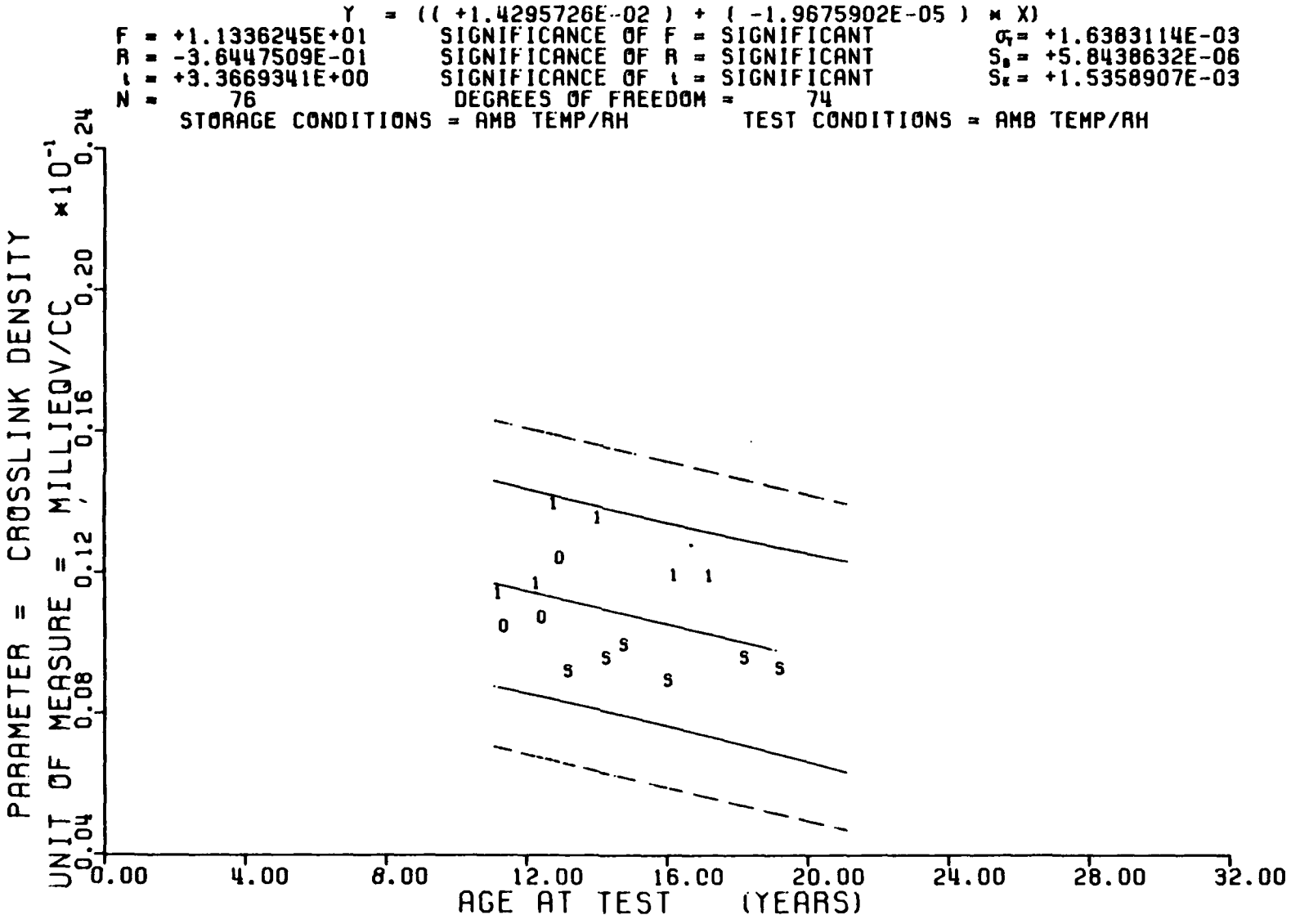

Y = ((+1.7899702E+00) + (-1.1621495E-04) * X)
F = +1.4213338E+01 SIGNIFICANCE OF F = SIGNIFICANT σ_Y = +8.7863957E-03
R = -4.0140327E-01 SIGNIFICANCE OF R = SIGNIFICANT S_B = +3.0825773E-05
t = +3.7700581E+00 SIGNIFICANCE OF t = SIGNIFICANT S_E = +8.1016647E-03
N = 76 DEGREES OF FREEDOM = 74
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = DENSITY
UNIT OF MEASURE = GRAMS/CC
1.82
1.80
1.78
1.76
1.74
1.72
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,DISSECTED MTRS=(0)0012099,(1)0012199,(S)STM-012, SOL GEL DENSITY.

Figure 46



DISSECTED MTR, STAGE 1, TP-H1011, SOL GEL, CROSSLINK DENSITY

Figure 47

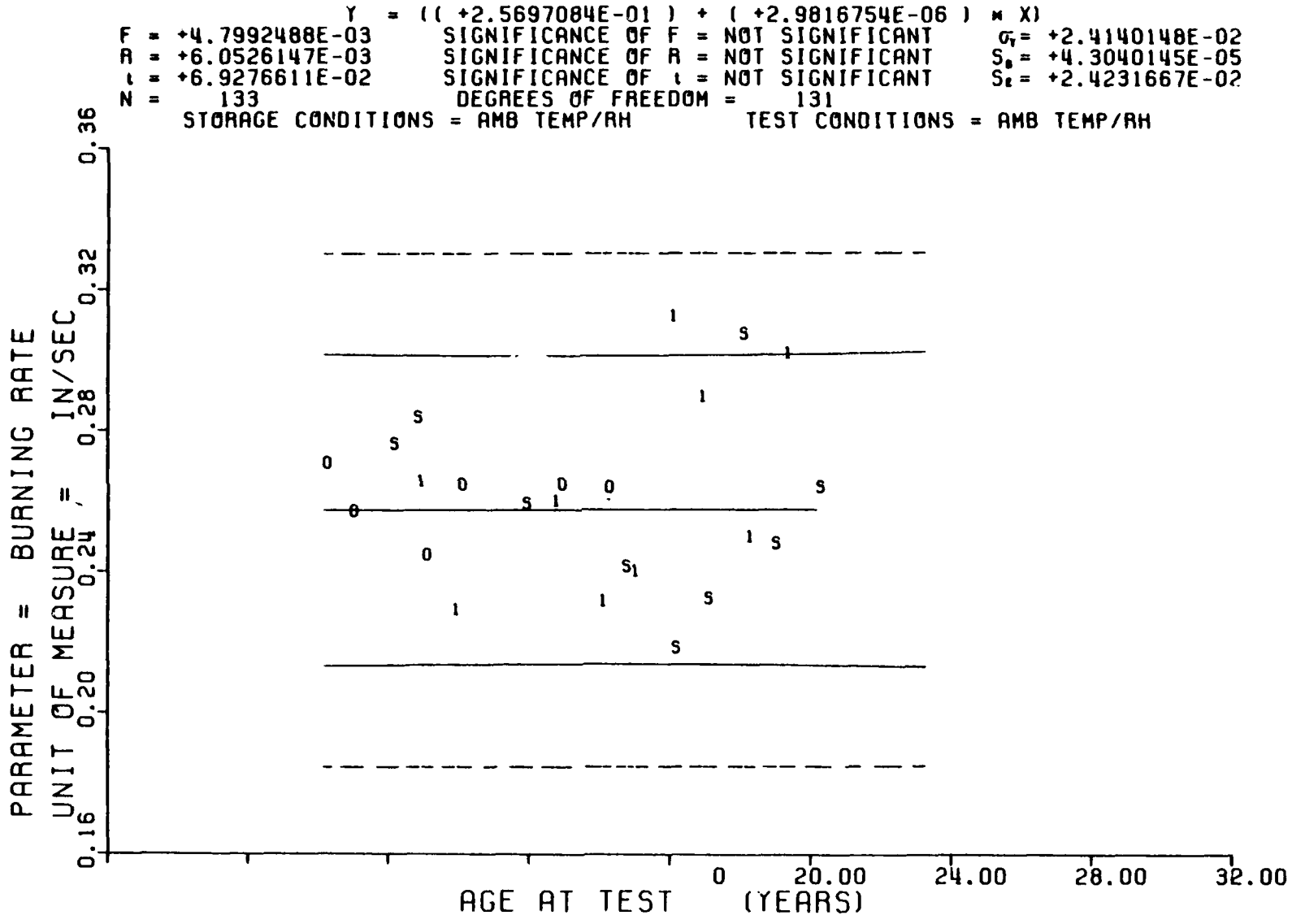

Y = ((+2.5697084E-01) + (+2.9816754E-06) * X)
F = +4.7992488E-03 SIGNIFICANCE OF F = NOT SIGNIFICANT σ = +2.4140148E-02
R = +6.0526147E-03 SIGNIFICANCE OF R = NOT SIGNIFICANT S = +4.3040145E-05
t = +6.9276611E-02 SIGNIFICANCE OF t = NOT SIGNIFICANT S = +2.4231667E-02
N = 133 DEGREES OF FREEDOM = 131
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = BURNING RATE
UNIT OF MEASURE = IN/SEC
0.36
0.32
0.28
0.24
0.20
0.16
0
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1 DISCTED MTRS= (0) 0012099, (1) 0012199, (S) STM-012, BURNING RATE AT 500 PSI.

Figure 48

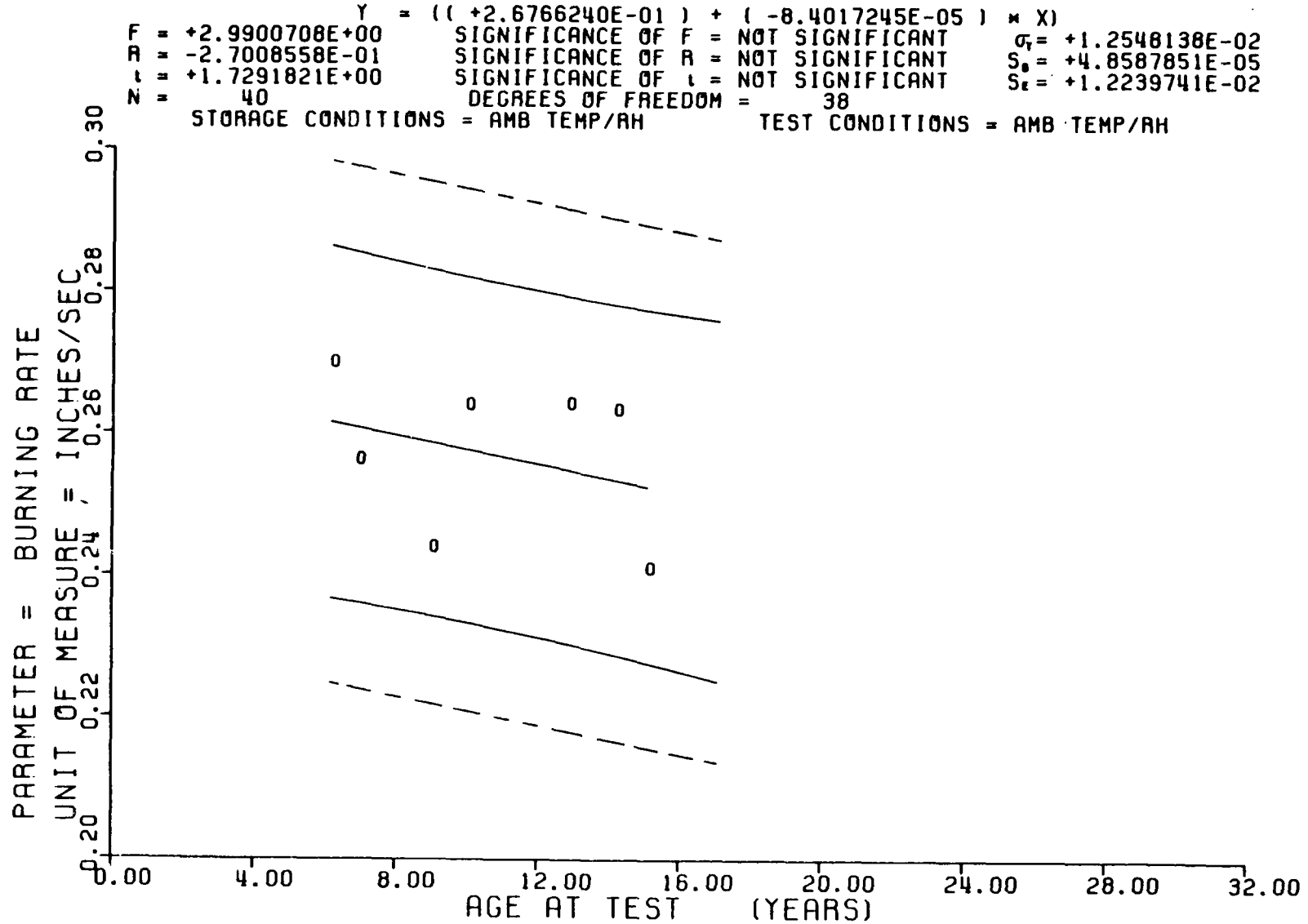
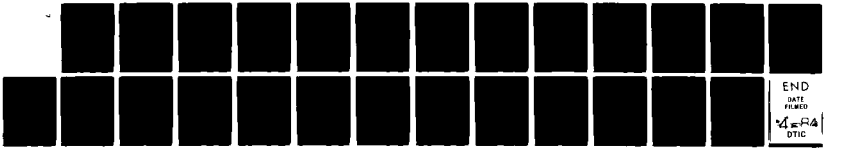
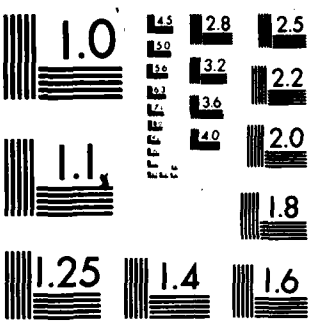

Y = ((+2.6766240E-01) + (-8.4017245E-05) * X)
F = +2.9900708E+00 SIGNIFICANCE OF F = NOT SIGNIFICANT σr = +1.2548138E-02
R = -2.7008558E-01 SIGNIFICANCE OF R = NOT SIGNIFICANT Sb = +4.8587851E-05
ι = +1.7291821E+00 SIGNIFICANCE OF ι = NOT SIGNIFICANT Sε = +1.2239741E-02
N = 40 DEGREES OF FREEDOM = 38
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = BURNING RATE
UNIT OF MEASURE = INCHES/SEC
0.30
0.28
0.26
0.24
0.22
0.20
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1, DISSECTED MOTOR= (0) 0012099, BURNING RATE AT 500 PSI INITIAL PRESSURE.

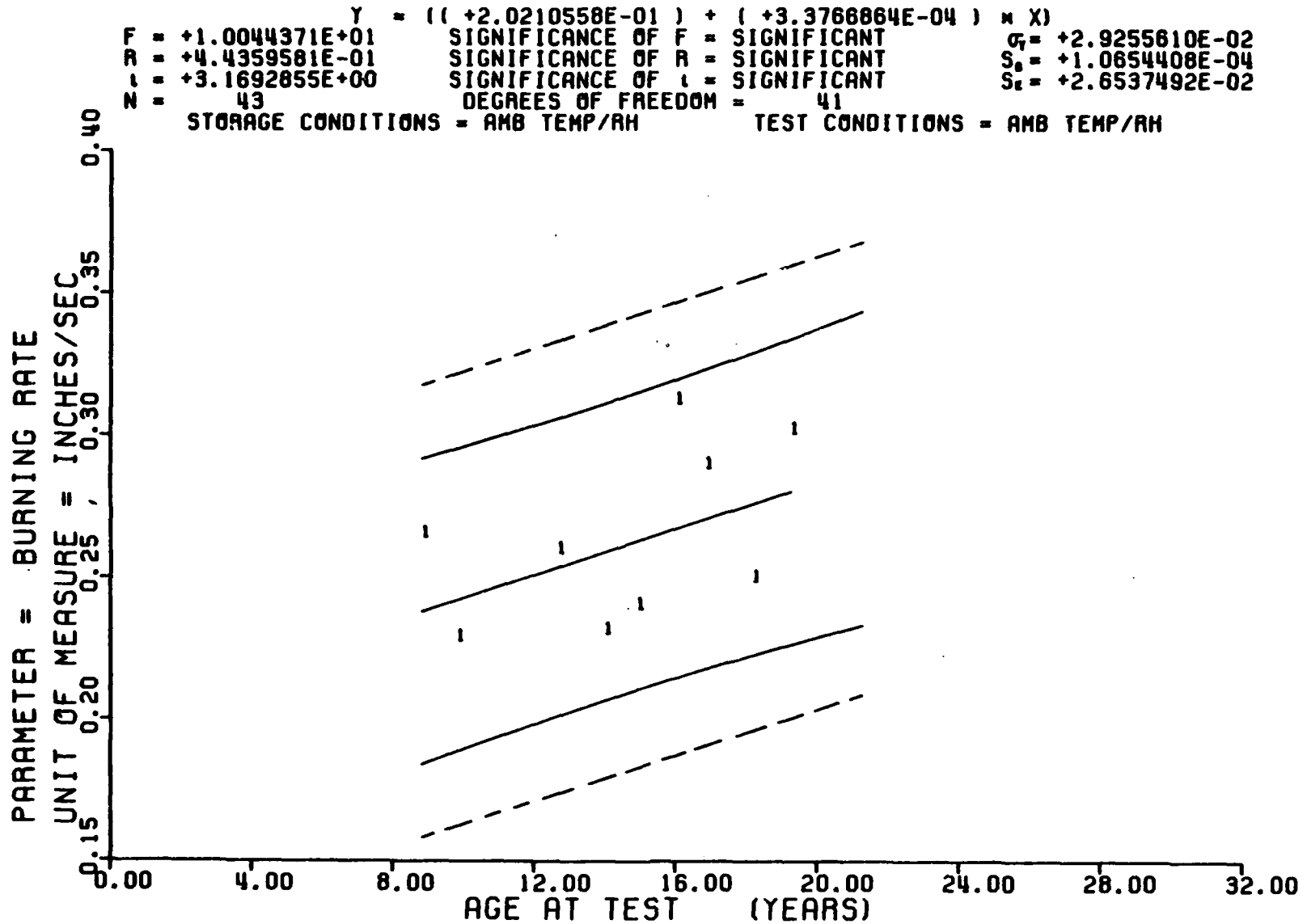
Figure 48A

AD-A139 201 SURVEILLANCE REPORT STAGE I DISSECTED MOTORS PHASE XIV PROPELLANT AND COM..(U) OGDEN AIR LOGISTICS CENTER HILL AFB UT PROPELLANT ANALYSIS LA.. J A THOMPSON DEC 83 2/2

UNCLASSIFIED MANPA-482(83) F/G 21/9.2 NL

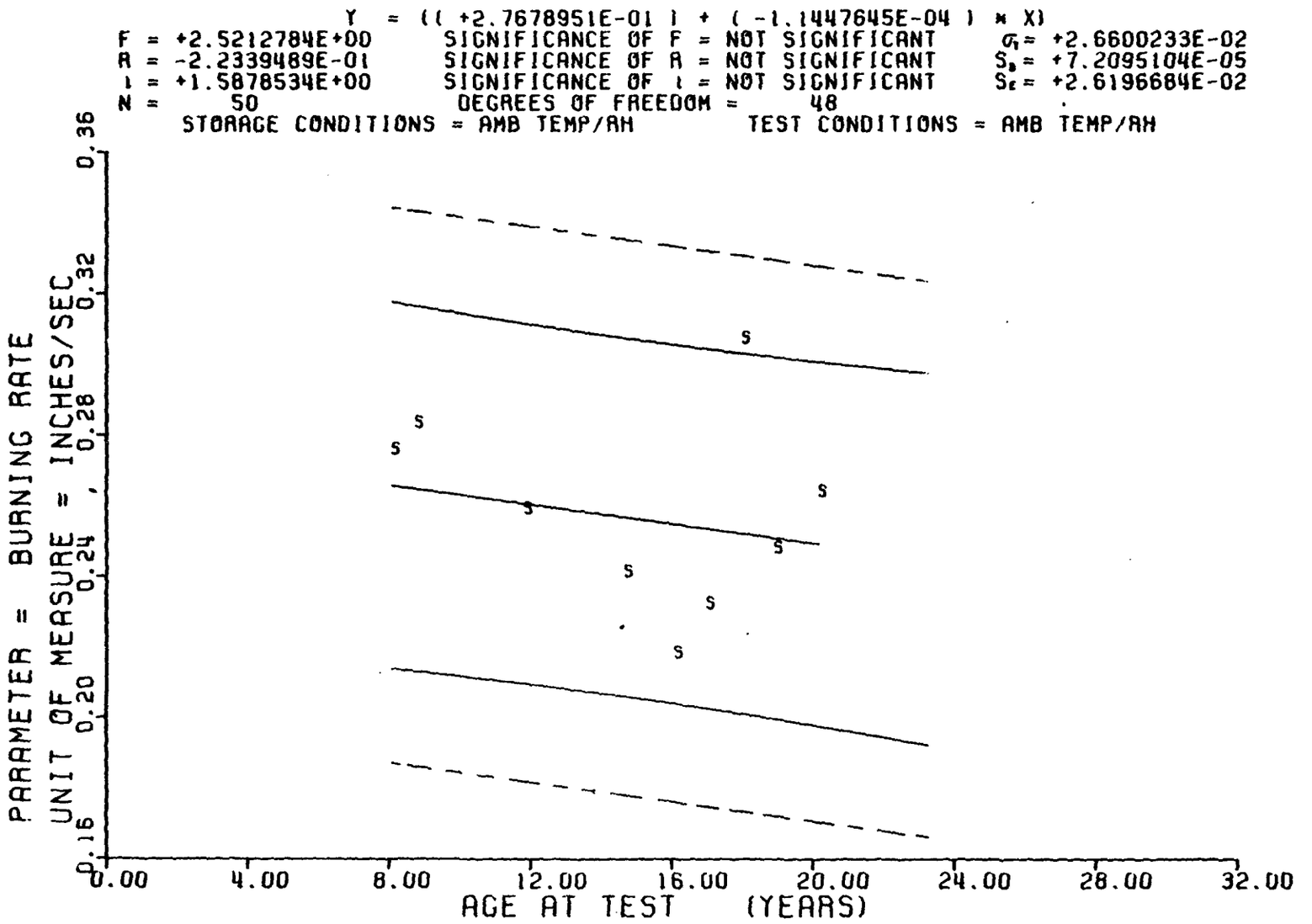






STAGE 1,DISSECTED MOTOR=(1)0012199,BURNING RATE AT 500 PSI INITIAL PRESSURE.

Figure 48B



STAGE 1, DISSECTED MOTOR= (S) STM-012, BURNING RATE AT 500 PSI INITIAL PRESSURE.

Figure 48C

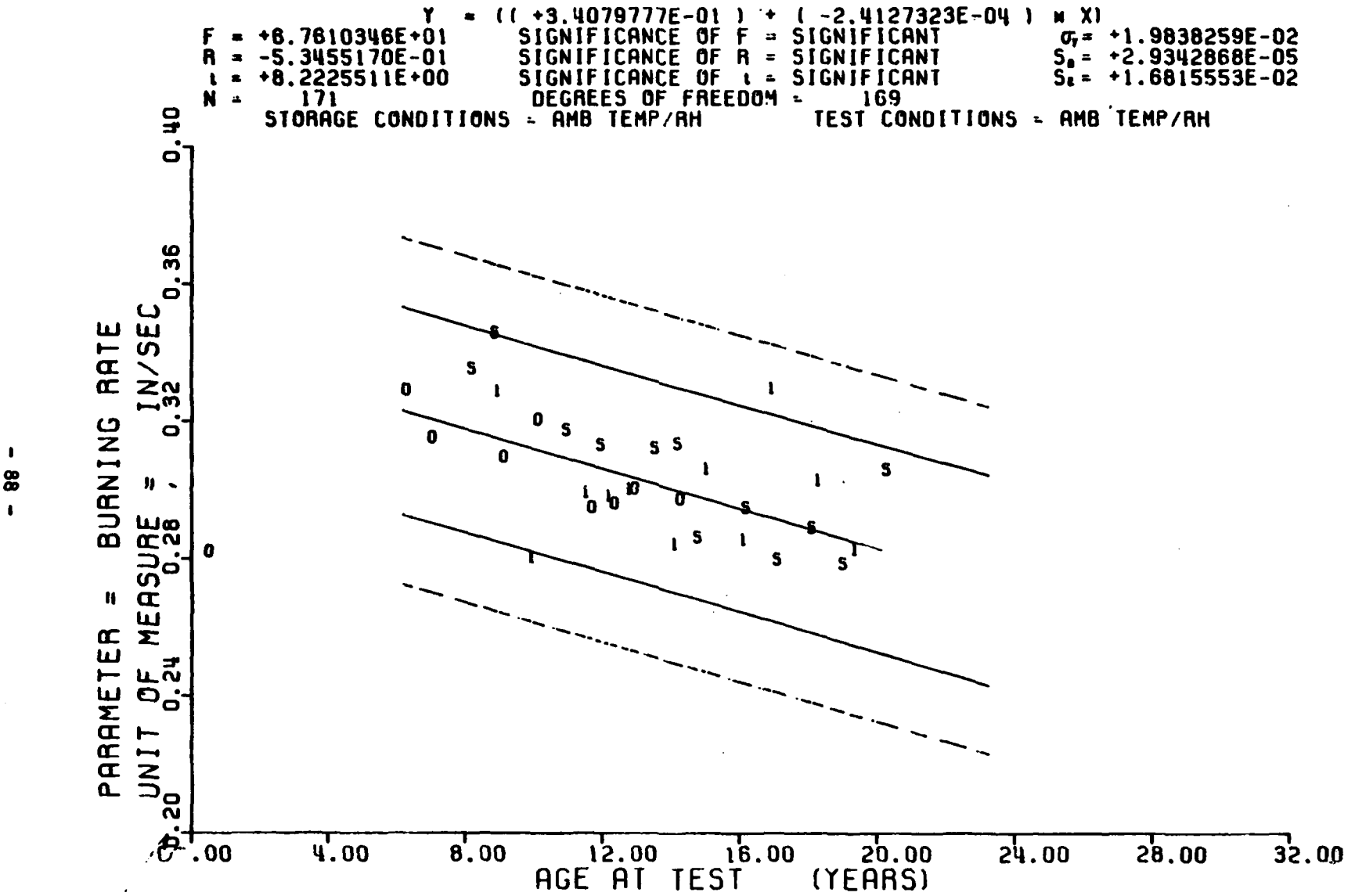

Y = ((+3.4079777E-01) + (-2.4127323E-04) M X)
F = +6.7610346E+01 SIGNIFICANCE OF F = SIGNIFICANT σ_Y = +1.9838259E-02
R = -5.3455170E-01 SIGNIFICANCE OF R = SIGNIFICANT S_a = +2.9342868E-05
t = +8.2225511E+00 SIGNIFICANCE OF t = SIGNIFICANT S_ε = +1.6815553E-02
N = 171 DEGREES OF FREEDOM = 169
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = BURNING RATE
UNIT OF MEASURE = IN/SEC
0.40
0.36
0.32
0.28
0.24
0.20
.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1 DISCTED MTRS= (0) 0012099, (1) 0012199, (S) STM-012, BURNING RATE AT 1000 PSI.

Figure 49

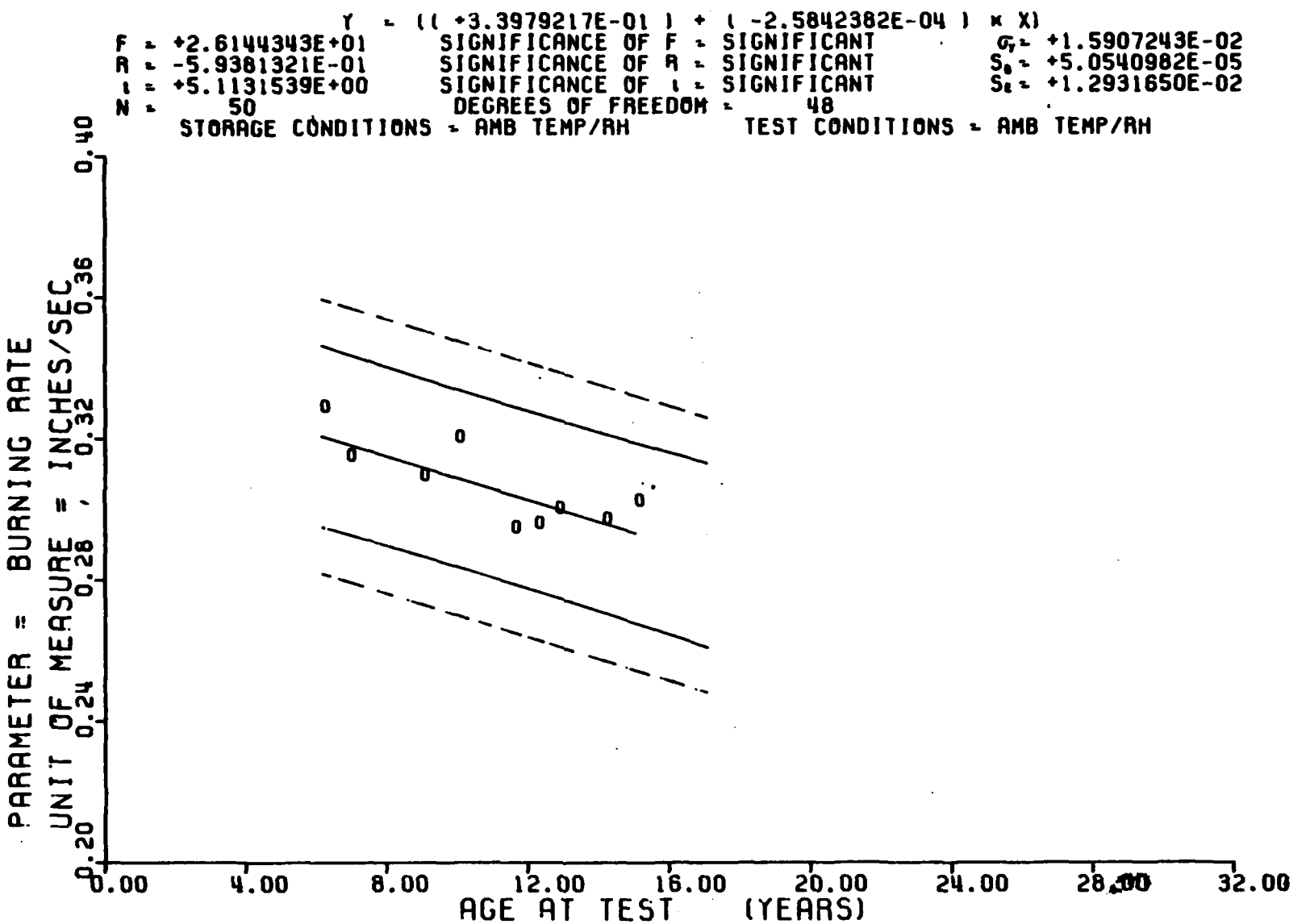

Y = ((+3.3979217E-01) + (-2.5842382E-04) × X)
F = +2.6144343E+01 SIGNIFICANCE OF F = SIGNIFICANT σy = +1.5907243E-02
R = -5.9381321E-01 SIGNIFICANCE OF R = SIGNIFICANT Sb = +5.0540982E-05
i = +5.1131539E+00 SIGNIFICANCE OF i = SIGNIFICANT Sε = +1.2931650E-02
N = 50 DEGREES OF FREEDOM = 48
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = BURNING RATE
UNIT OF MEASURE = INCHES/SEC
0.40
0.36
0.32
0.28
0.24
0.20
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,DISSECTED MOTOR= (0)0012099,BURNING RATE AT 1000 PSI INITIAL PRESSURE.

Figure 49A

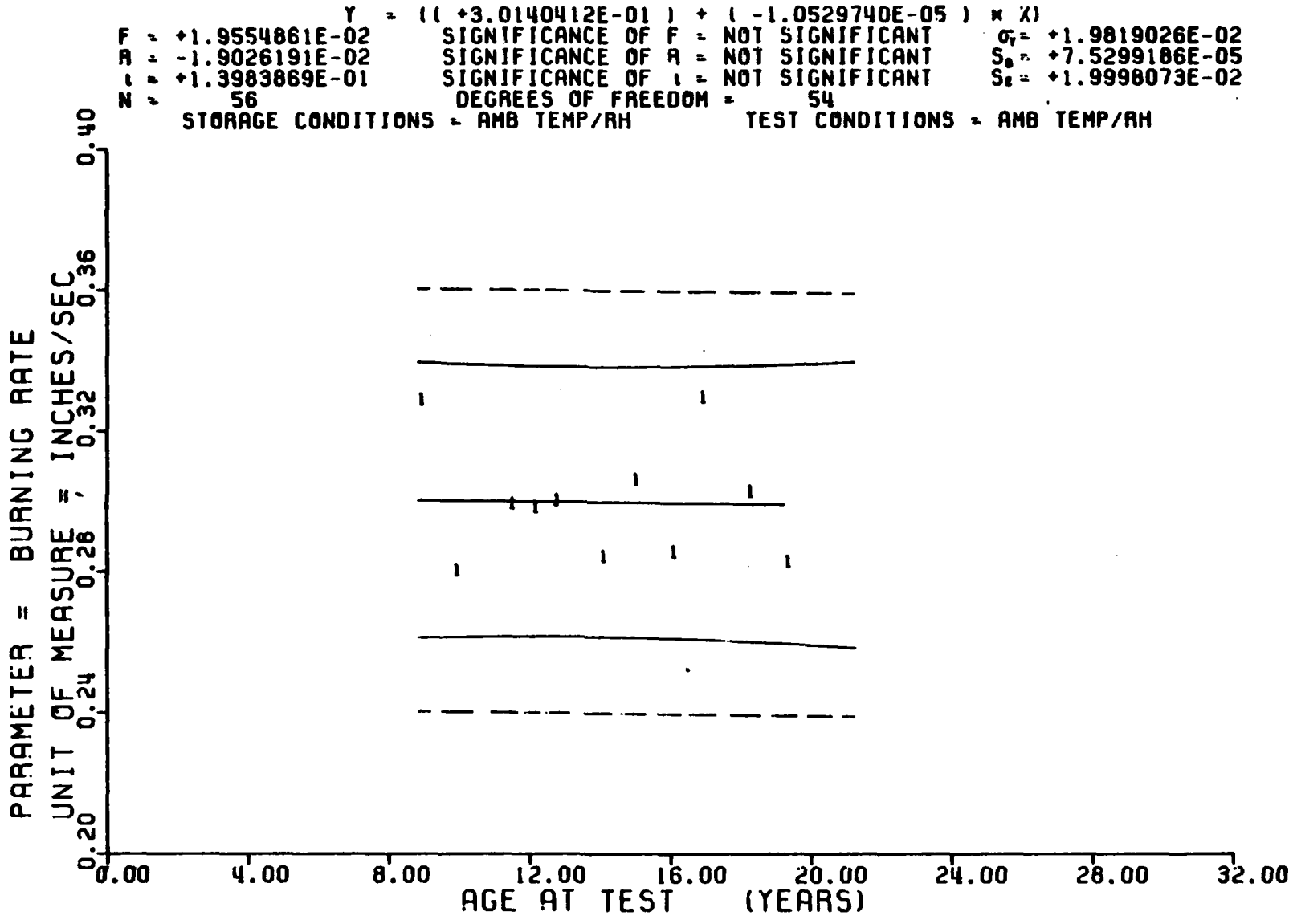
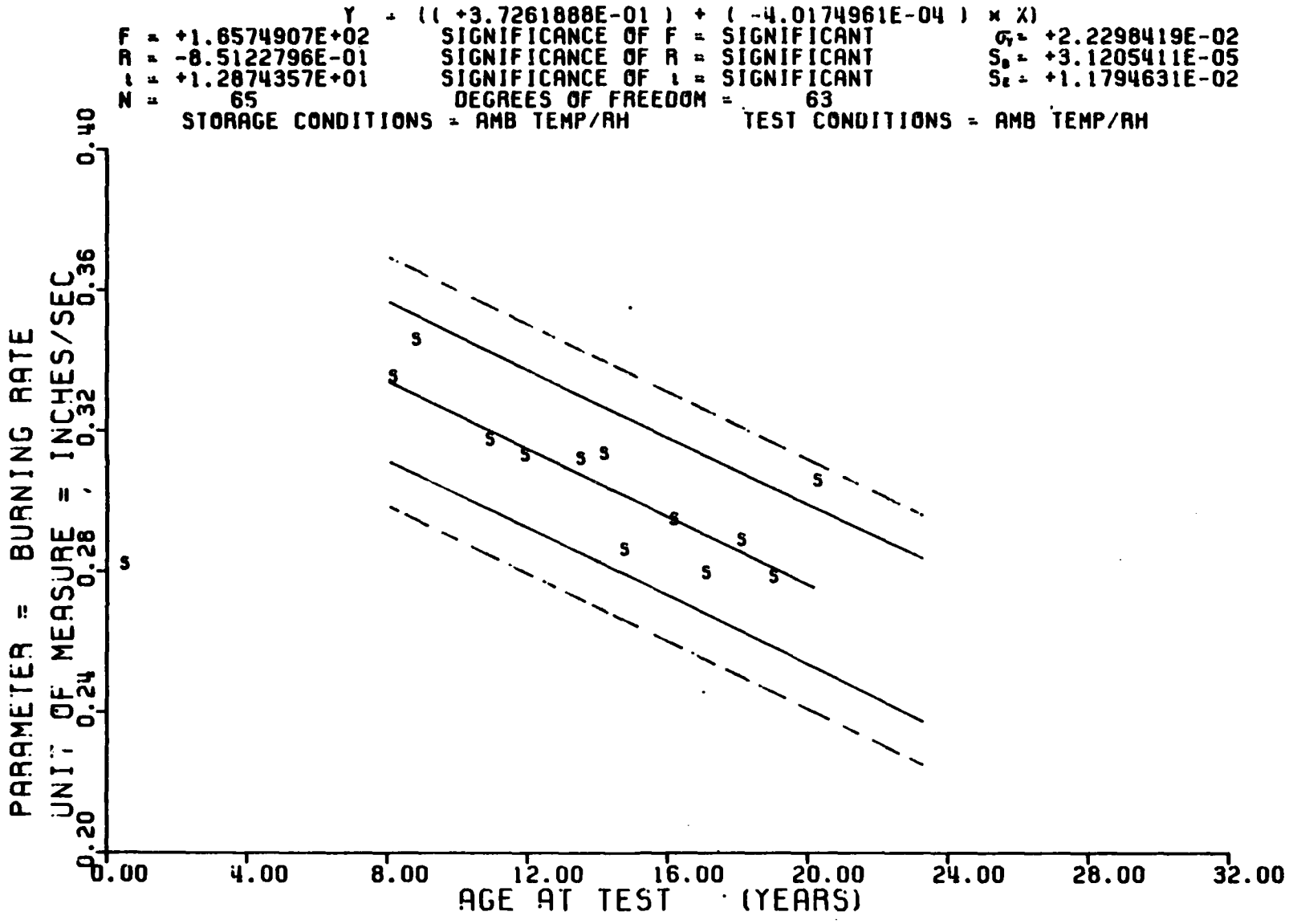

Y = ((+3.0140412E-01) + (-1.0529740E-05) * X)
F = +1.9554861E-02 SIGNIFICANCE OF F = NOT SIGNIFICANT σ = +1.9819026E-02
R = -1.9026191E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT S = +7.5299186E-05
t = +1.3983869E-01 SIGNIFICANCE OF t = NOT SIGNIFICANT S = +1.9998073E-02
N = 56 DEGREES OF FREEDOM = 54
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = BURNING RATE
UNIT OF MEASURE = INCHES/SEC
0.40
0.36
0.32
0.28
0.24
0.20
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,DISSECTED MOTOR= (1)0012199,BURNING RATE AT 1000 PSI INITIAL PRESSURE.

Figure 49B



STAGE 1, DISSECTED MOTOR (S) STM-012, BURNING RATE AT 1000 PSI INITIAL PRESSURE.

Figure 49C

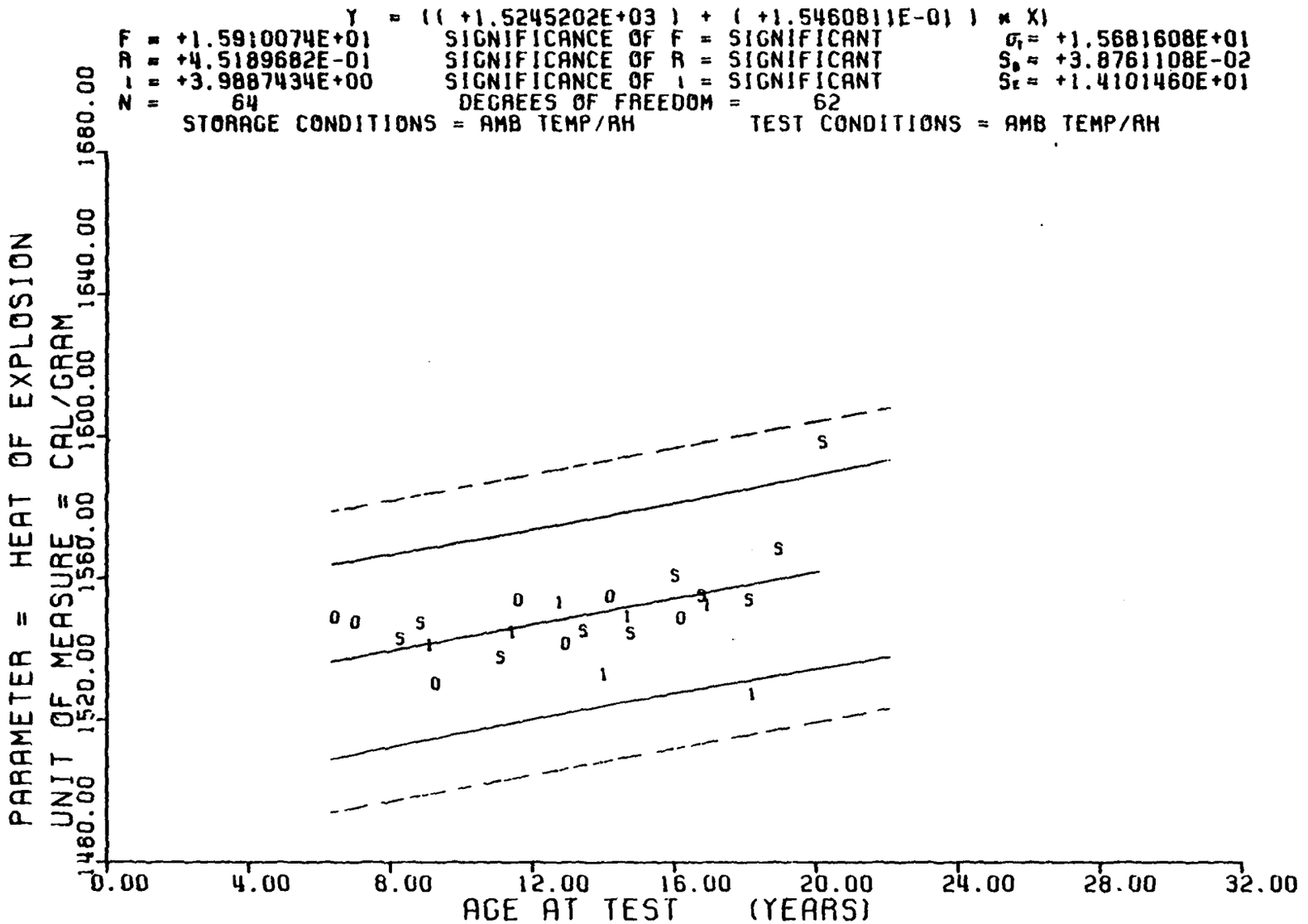
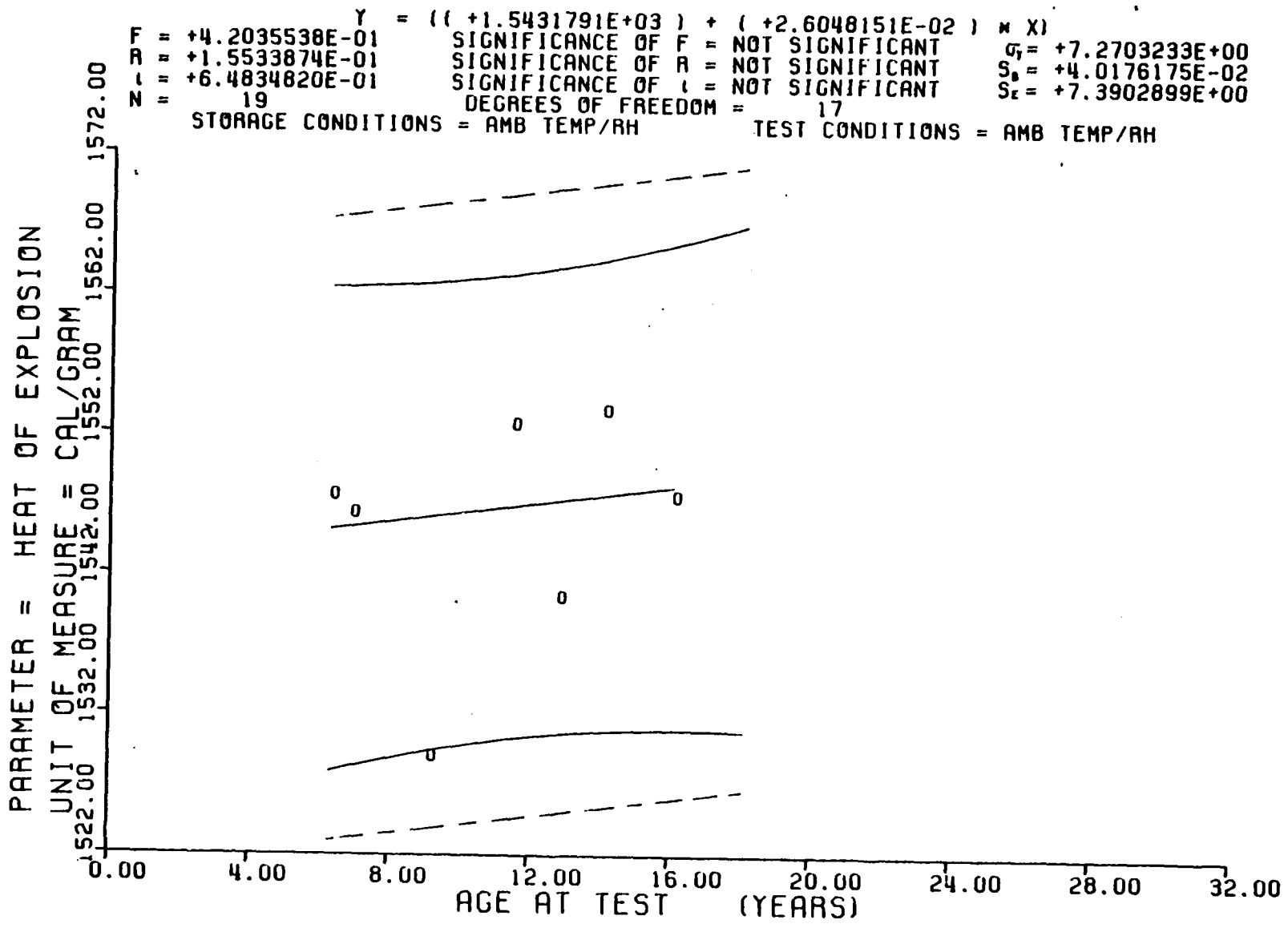
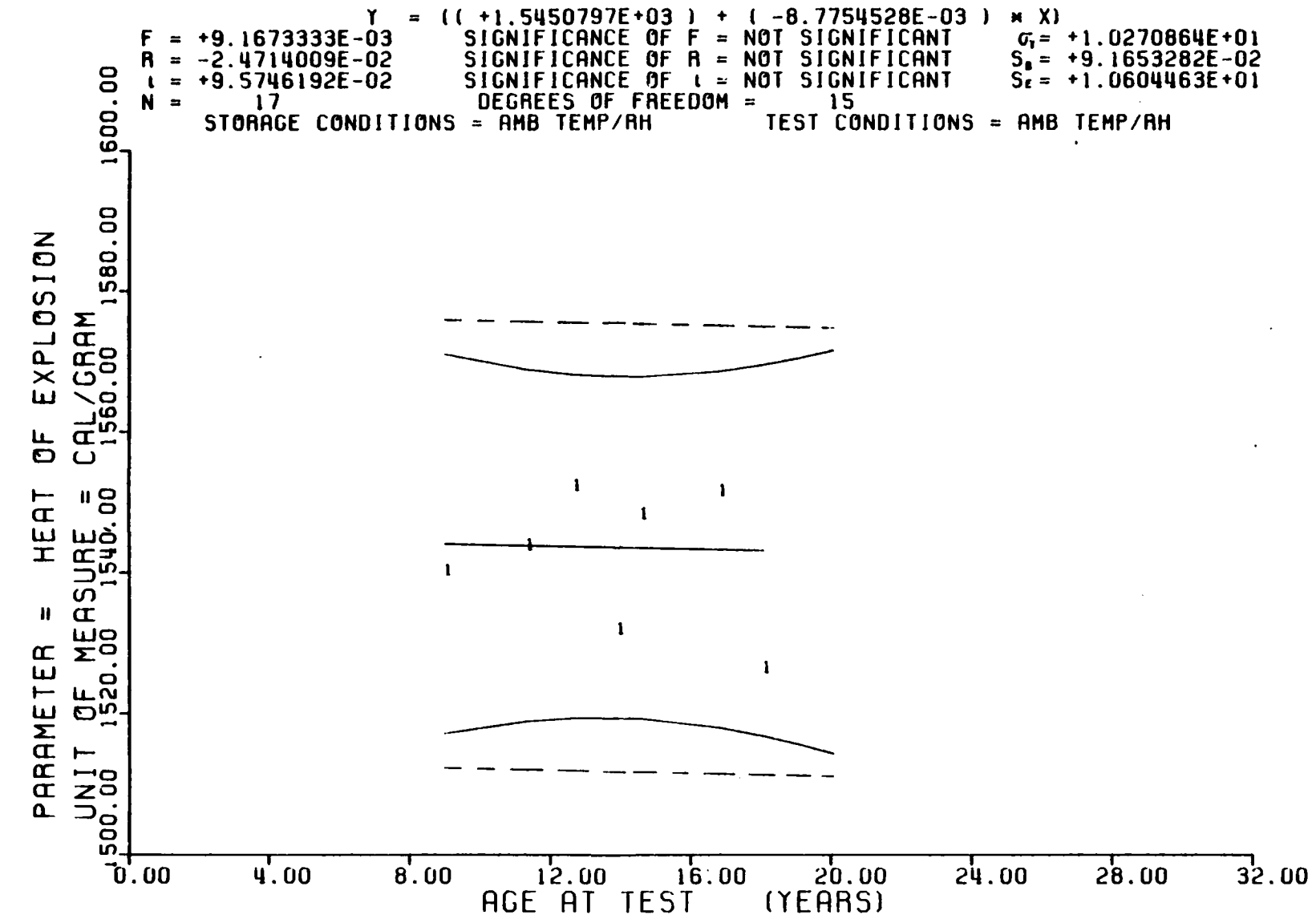

Y = ((+1.5245202E+03) + (+1.5460811E-01) * X)
F = +1.5910074E+01 SIGNIFICANCE OF F = SIGNIFICANT σt = +1.5681608E+01
R = +4.5189682E-01 SIGNIFICANCE OF R = SIGNIFICANT Sb = +3.8761108E-02
ι = +3.9887434E+00 SIGNIFICANCE OF ι = SIGNIFICANT Se = +1.4101460E+01
N = 64 DEGREES OF FREEDOM = 62
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = HEAT OF EXPLOSION
UNIT OF MEASURE = CAL/GRAM
1480.00
1520.00
1560.00
1600.00
1640.00
1680.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1 DISSECTED MOTORS, HEAT OF EXPLOSION

Figure 50



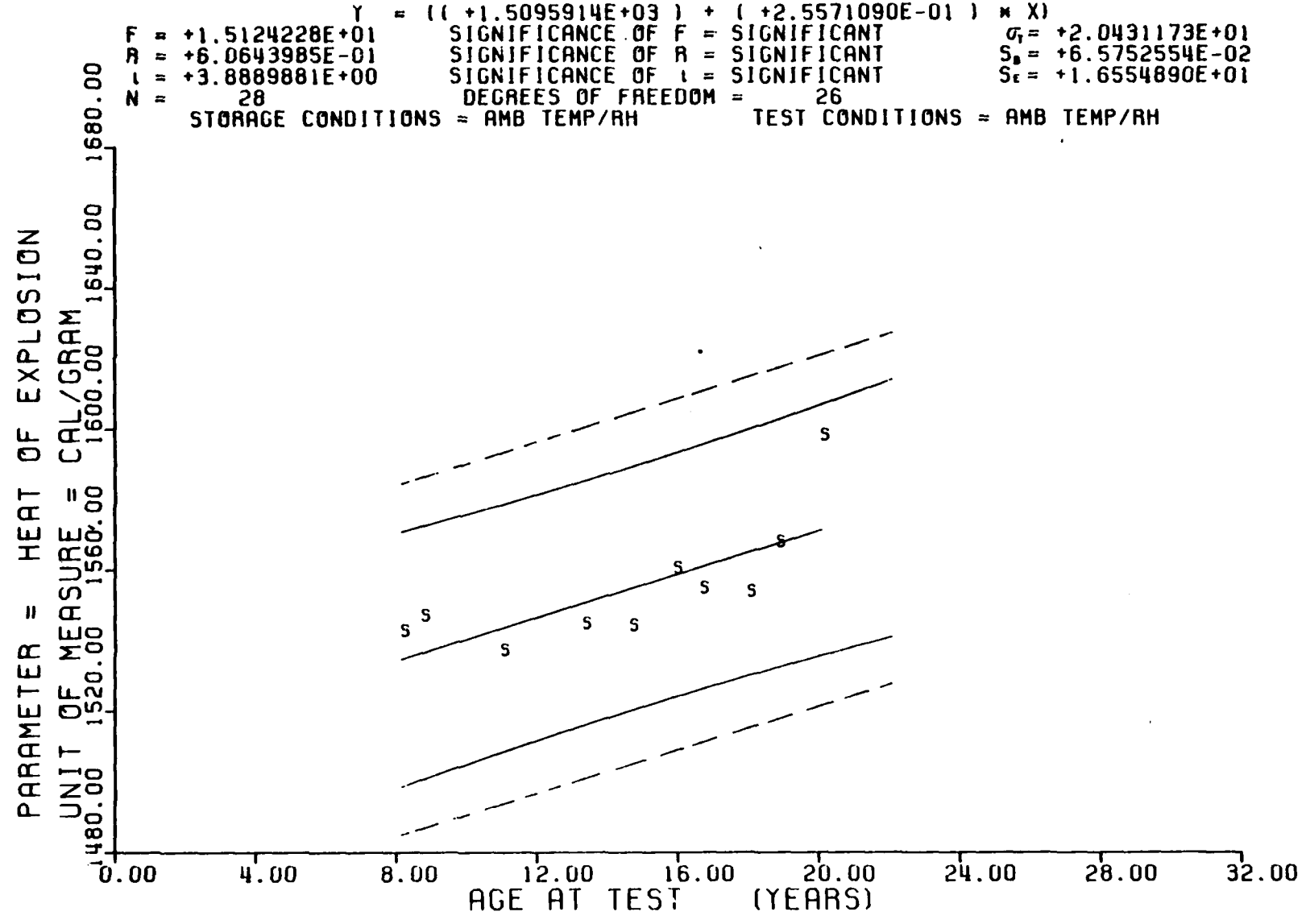
STAGE 1, DISSECTED MOTOR=0012099, HEAT RELEASED AT IGNITION.

Figure 50A



STAGE 1, DISSECTED MOTOR=0012199, HEAT RELEASED AT IGNITION.

Figure 50B



STAGE 1, DISSECTED MOTOR=STM-012, HEAT RELEASED AT IGNITION.

Figure 50C

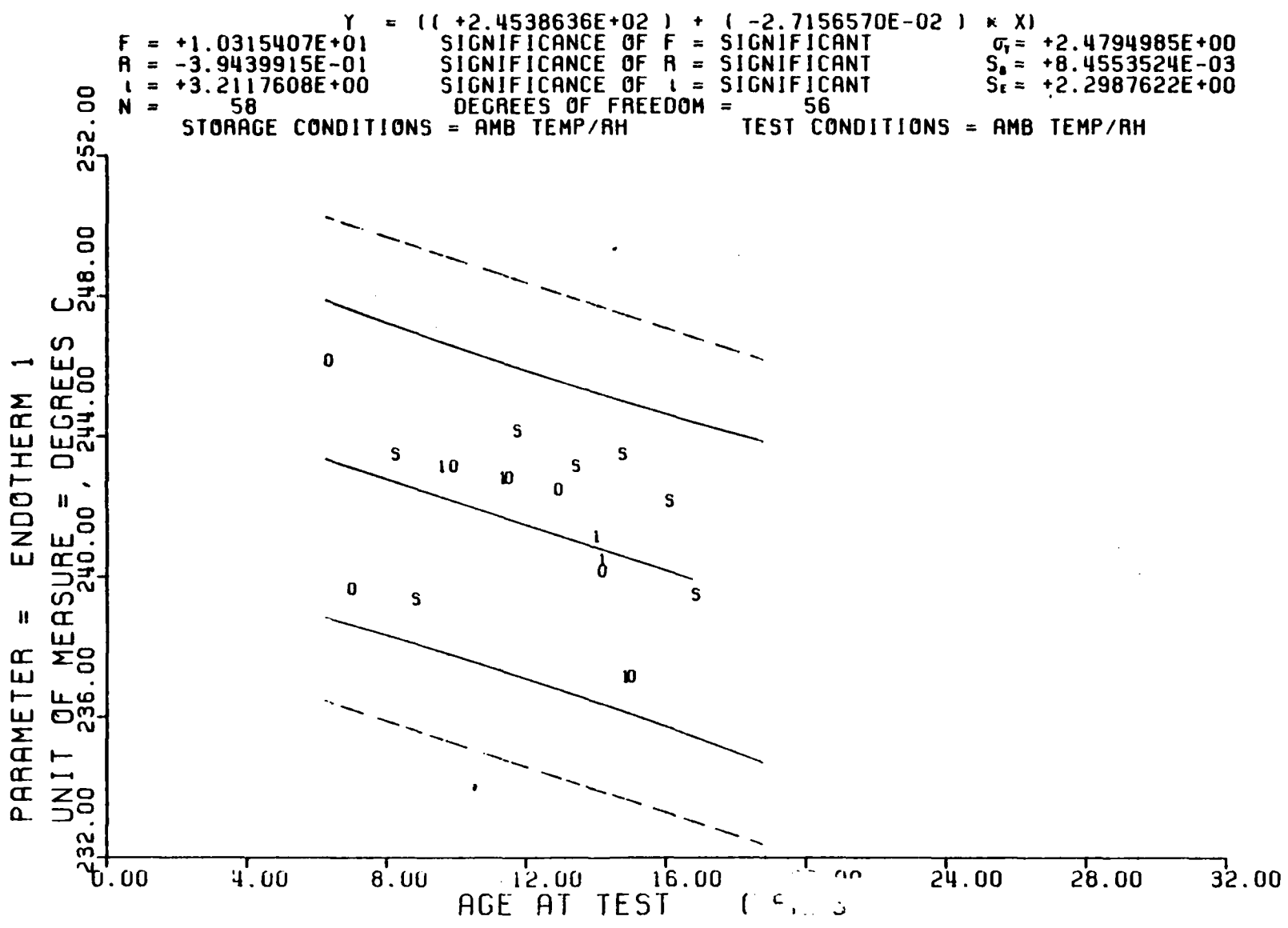
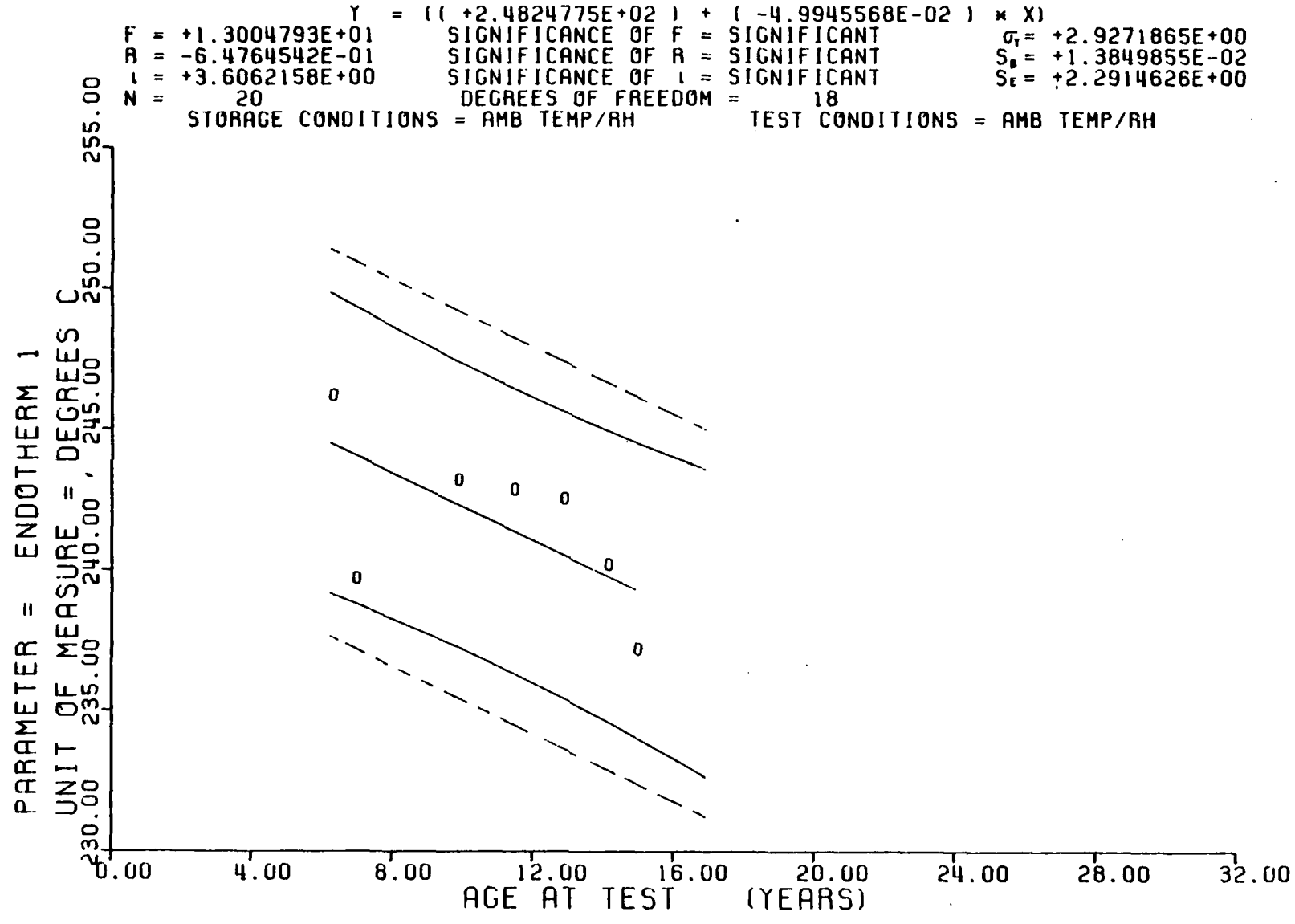

Y = ((+2.4538636E+02) + (-2.7156570E-02) * X)
F = +1.0315407E+01 SIGNIFICANCE OF F = SIGNIFICANT σ1 = +2.4794985E+00
R = -3.9439915E-01 SIGNIFICANCE OF R = SIGNIFICANT Sb = +8.4553524E-03
I = +3.2117608E+00 SIGNIFICANCE OF I = SIGNIFICANT Se = +2.2987622E+00
N = 58 DEGREES OF FREEDOM = 56
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = ENDOTHERM 1
UNIT OF MEASURE = DEGREES C
252.00
248.00
244.00
240.00
236.00
232.00
0.00
4.00
8.00
12.00
16.00
24.00
28.00
32.00
AGE AT TEST
STAGE 1,DSCTD MTRS=(0)0012099, (1)0012199, (S)STM-012,DTA,12 DEG C RISE/MIN.

Figure 51



STAGE 1,DISSECTED MTR=(0)0012099,DTA,ENDOTHERM 1, 12 DEG C RISE/MIN.

Figure 51A

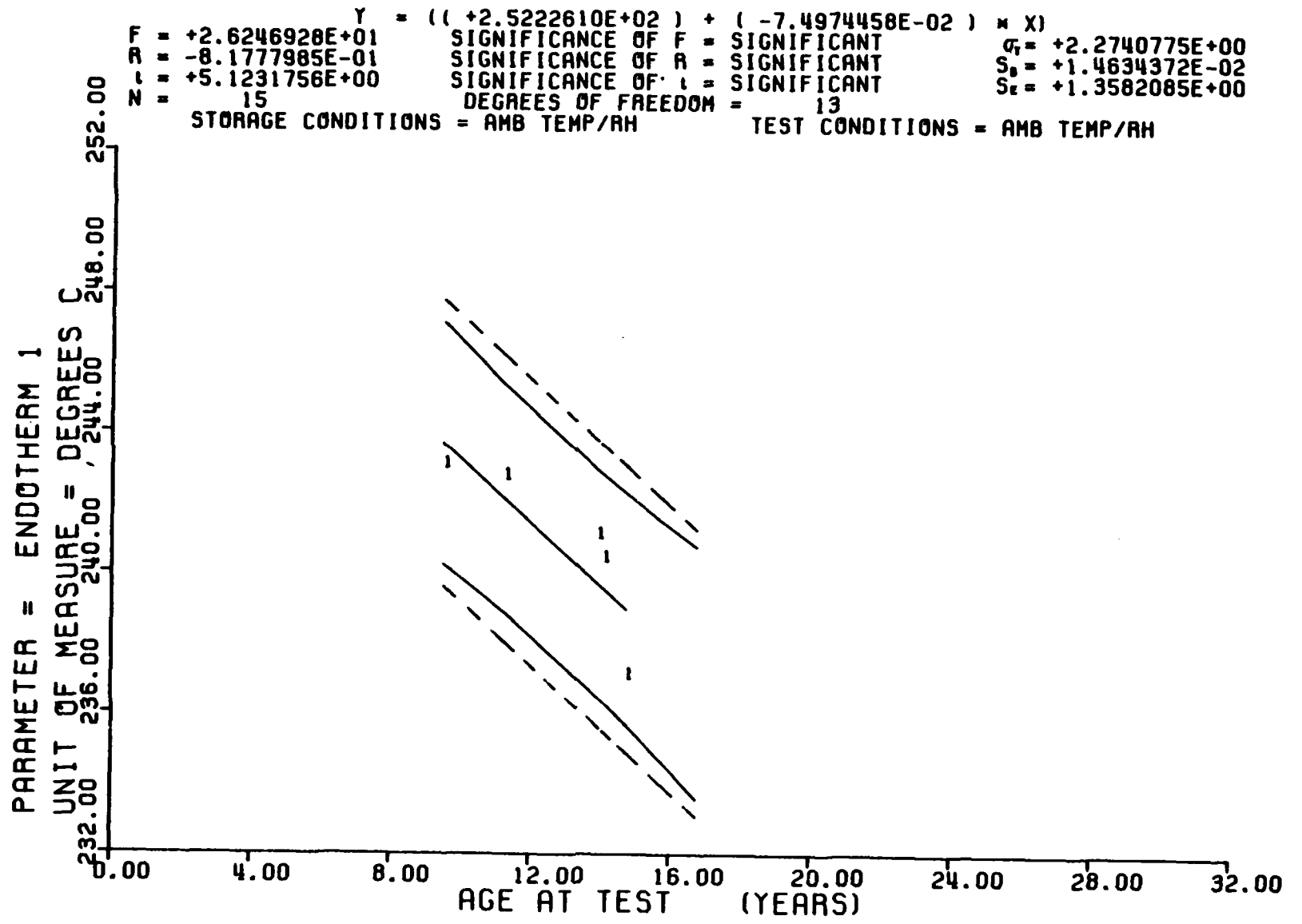
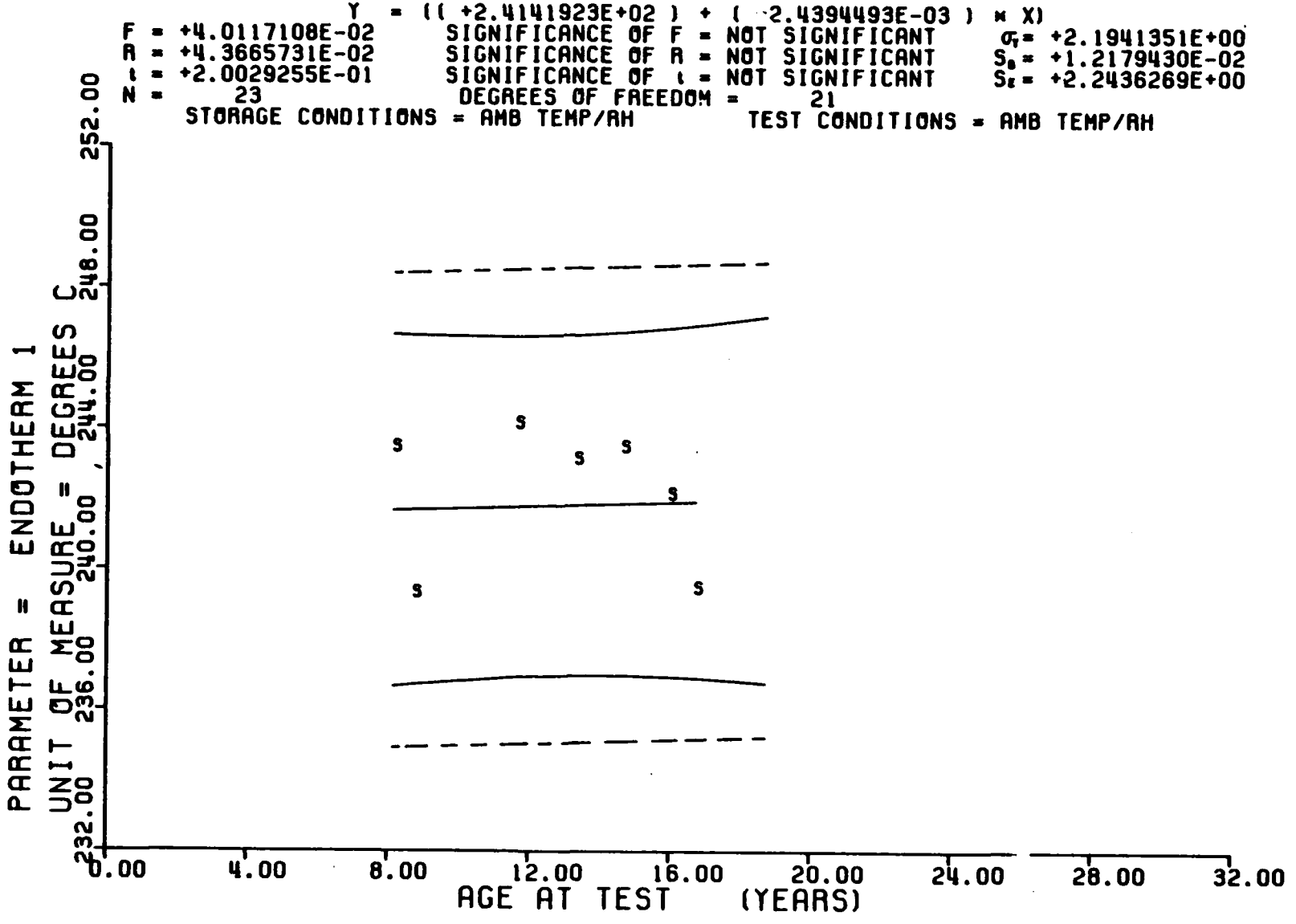
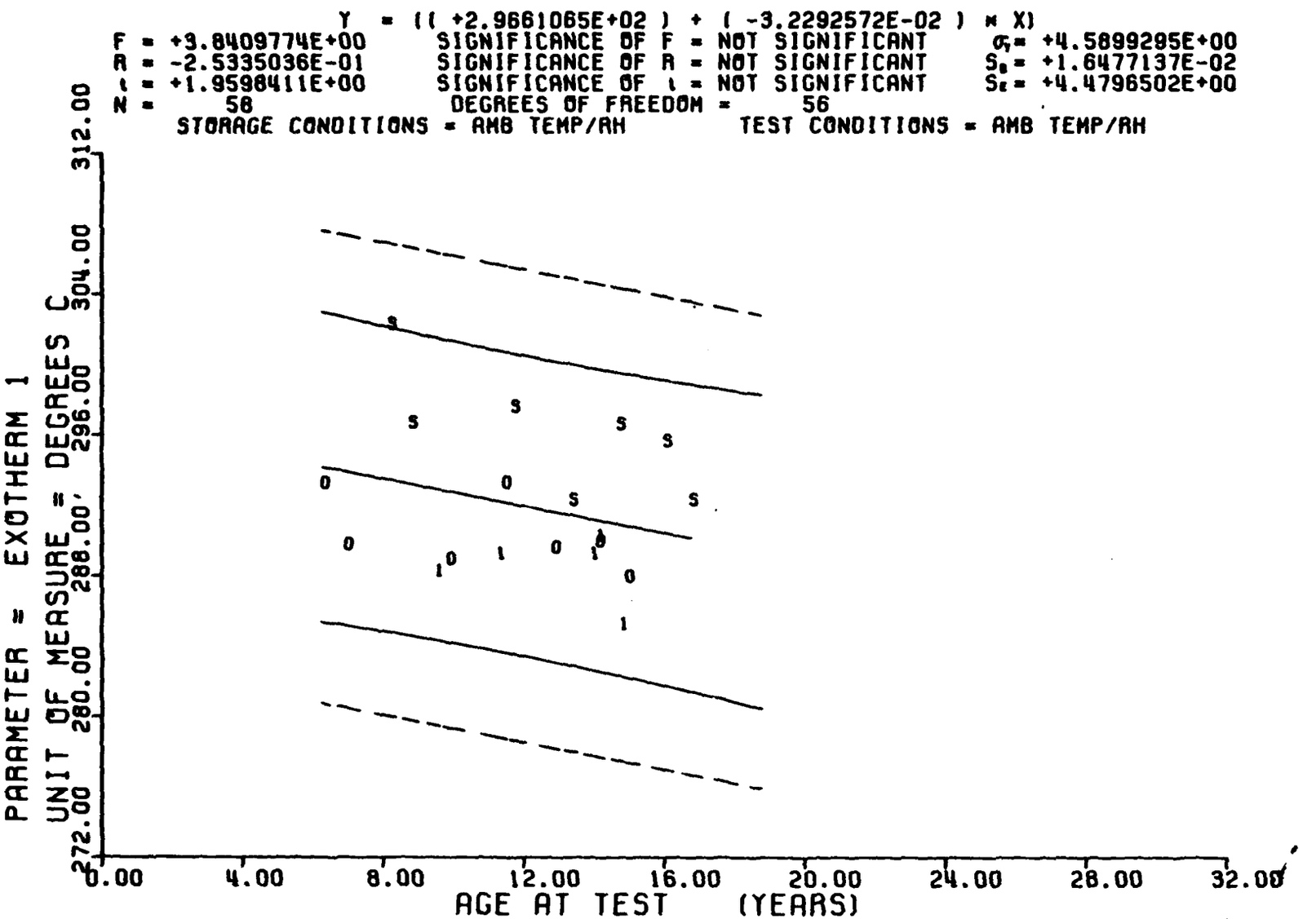

Y = ((+2.5222610E+02) + (-7.4974458E-02) * X)
F = +2.6246928E+01 SIGNIFICANCE OF F = SIGNIFICANT σr = +2.2740775E+00
R = -8.1777985E-01 SIGNIFICANCE OF R = SIGNIFICANT Sb = +1.4634372E-02
t = +5.1231756E+00 SIGNIFICANCE OF t = SIGNIFICANT Sε = +1.3582085E+00
N = 15 DEGREES OF FREEDOM = 13
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = ENDOTHERM 1
UNIT OF MEASURE = DEGREES C
252.00
248.00
244.00
240.00
236.00
232.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,DISSECTED MTR=(1)0012199,DTA,ENDOTHERM 1, 12 DEG C RISE/MIN.

Figure 51B



STAGE 1,DISSECTED MTR=(S)STM-012,DTA,ENDOTHERM 1, 12 DEG C RISE/MIN.

Figure 51C



STAGE 1,DSCTD MTRS=(0)0012099,(1)0012199,(S)STM-012,DTA,12 DEG C RISE/MIN.

Figure 52

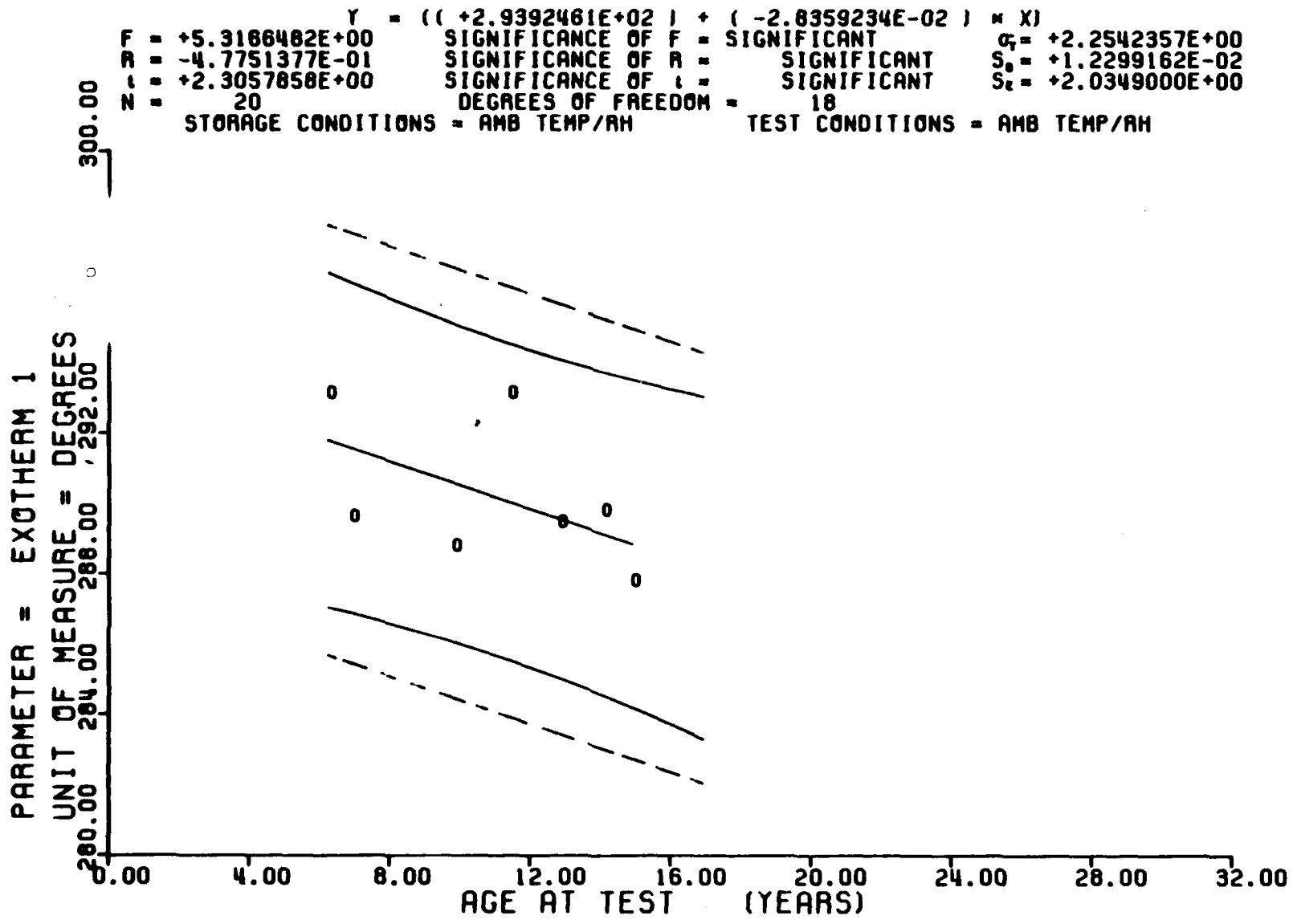
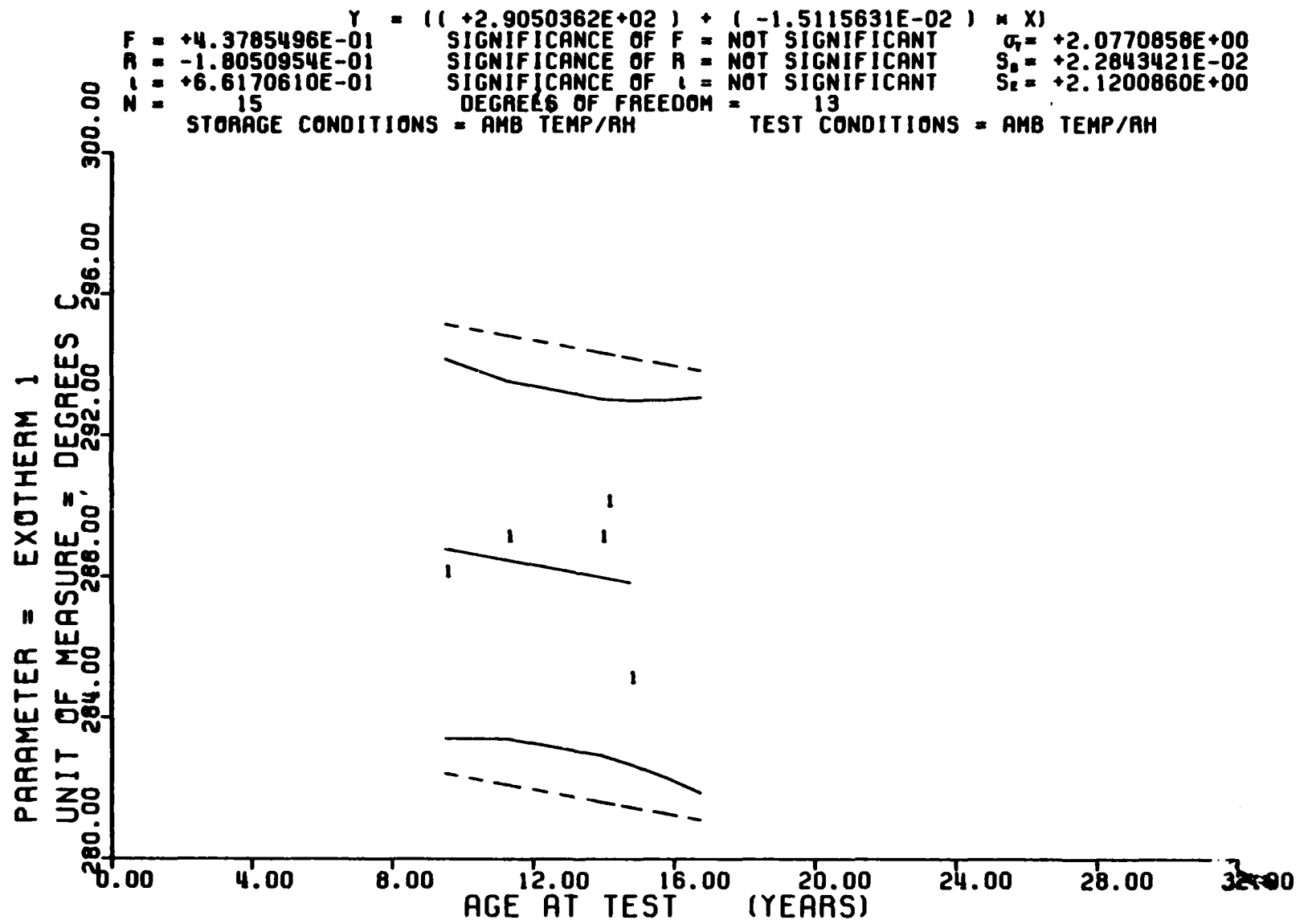

Y = ((+2.9392461E+02) + (-2.8359234E-02) * X)
F = +5.3166482E+00 SIGNIFICANCE OF F = SIGNIFICANT σ_r = +2.2542357E+00
R = -4.7751377E-01 SIGNIFICANCE OF R = SIGNIFICANT S_e = +1.2299162E-02
t = +2.3057858E+00 SIGNIFICANCE OF t = SIGNIFICANT S_t = +2.0349000E+00
N = 20 DEGREES OF FREEDOM = 18
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = EXOTHERM 1
UNIT OF MEASURE = DEGREES
300.00
292.00
288.00
284.00
280.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,DISSECTED MTR=(0)0012099,DTA,EXOTHERM 1, 12 DEG C RISE/MIN.

Figure 52A



STAGE 1,DISSECTED MTR=(1)0012199,DTA,EXOTHERM 1, 12 DEG C RISE/MIN.

Figure 52B

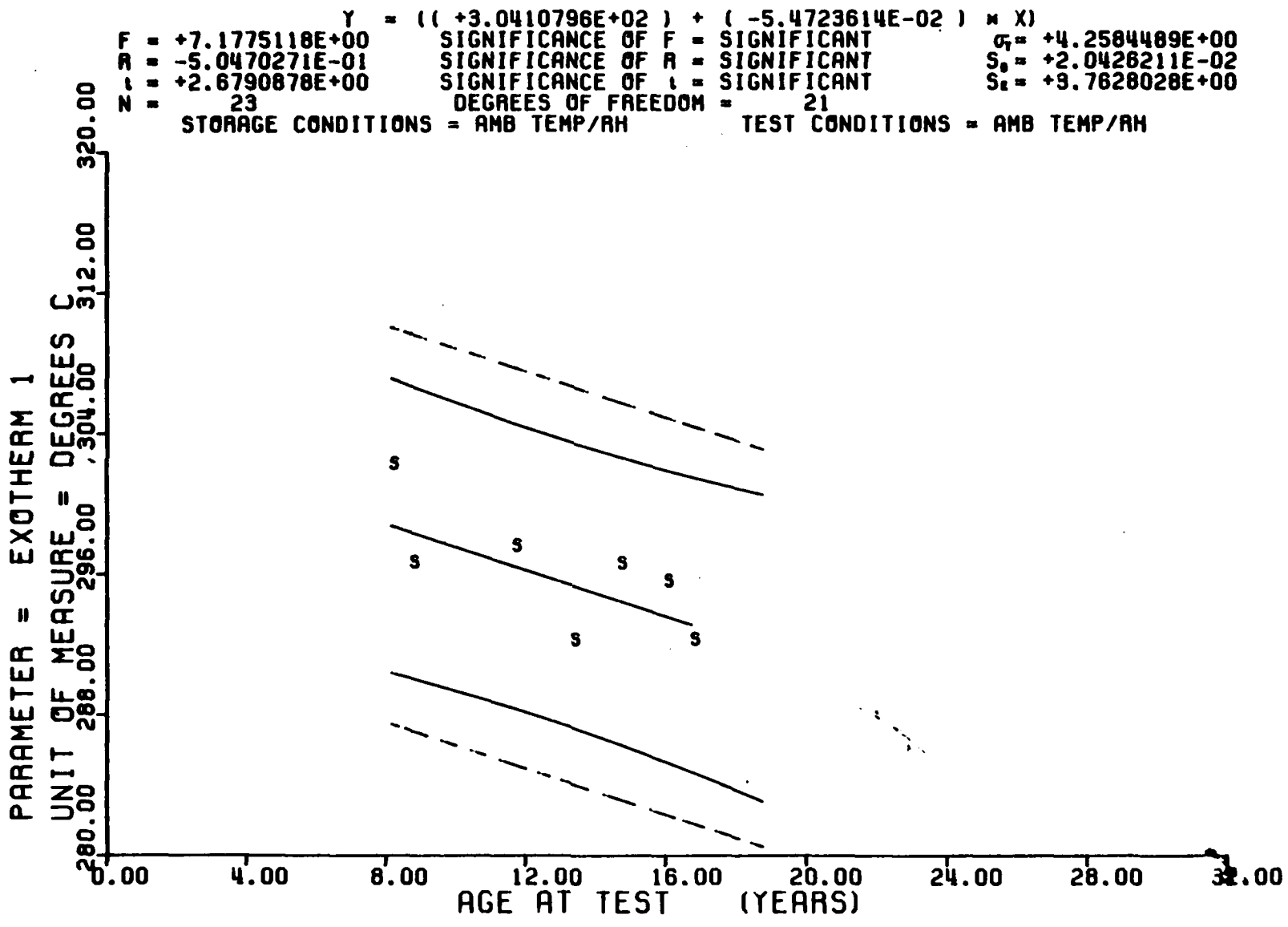

Y = ((+3.0410796E+02) + (-5.4723614E-02) * X)
F = +7.1775118E+00 SIGNIFICANCE OF F = SIGNIFICANT σ = +4.2584489E+00
R = -5.0470271E-01 SIGNIFICANCE OF R = SIGNIFICANT S = +2.0426211E-02
t = +2.6790878E+00 SIGNIFICANCE OF t = SIGNIFICANT S = +9.7628028E+00
N = 23 DEGREES OF FREEDOM = 21
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = EXOTHERM 1
UNIT OF MEASURE = DEGREES C
320.00
312.00
304.00
296.00
288.00
280.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,DISSECTED MTR=(S)STM-012,DTA,EXOTHERM 1, 12 DEG C RISE/MIN.

Figure 52C

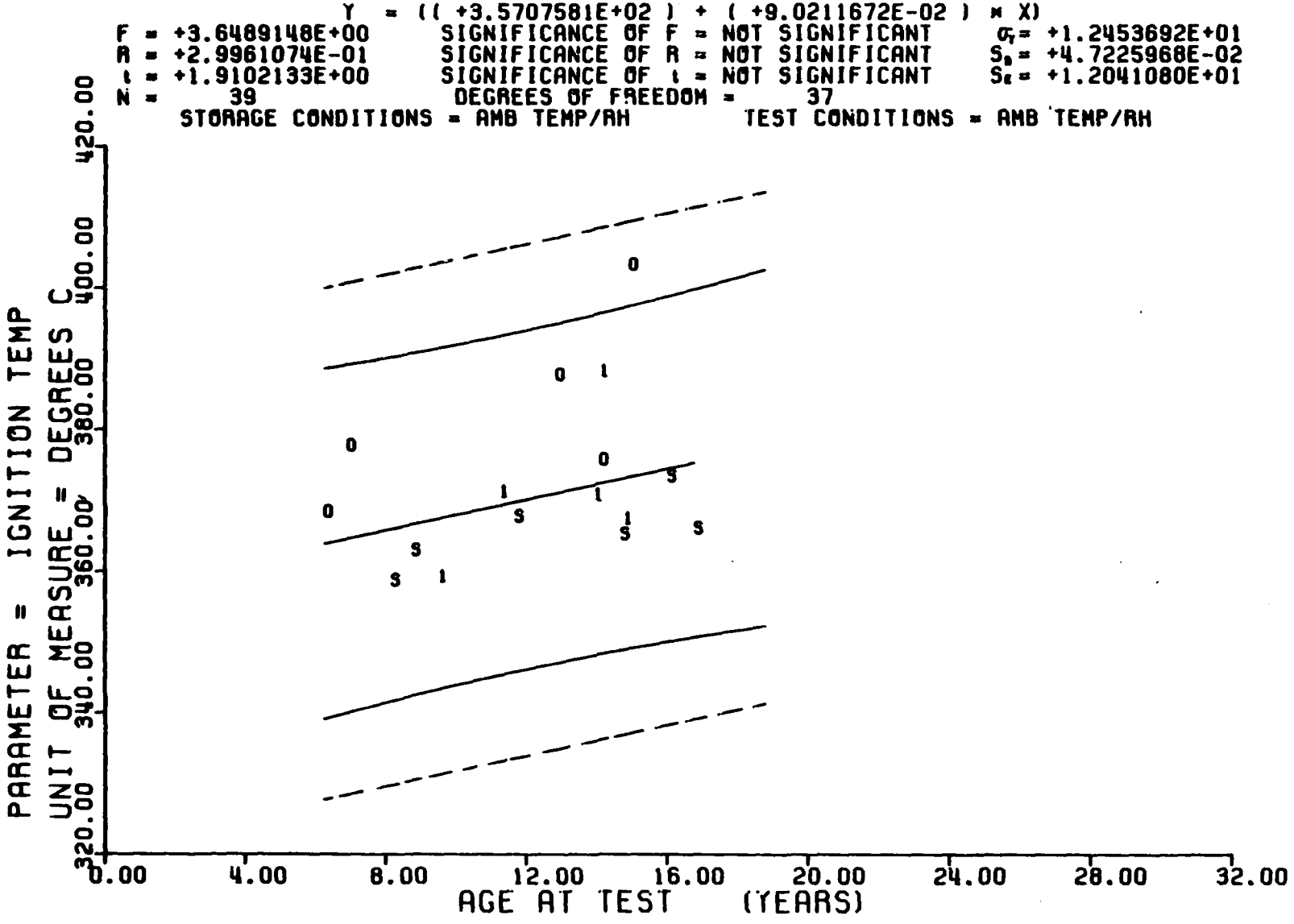

Y = ((+3.5707581E+02) + (+9.0211672E-02) * X)
F = +3.6489148E+00 SIGNIFICANCE OF F = NOT SIGNIFICANT σT = +1.2453692E+01
R = +2.9961074E-01 SIGNIFICANCE OF R = NOT SIGNIFICANT Sb = +4.7225968E-02
t = +1.9102133E+00 SIGNIFICANCE OF t = NOT SIGNIFICANT Se = +1.2041080E+01
N = 39 DEGREES OF FREEDOM = 37
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = IGNITION TEMP
UNIT OF MEASURE = DEGREES C
420.00
400.00
380.00
360.00
340.00
320.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1.DSCTD MTRS=(0)0012099, (1)0012199, (S)STM-012.DTA,12 DEG C RISE/MIN.

Figure 53

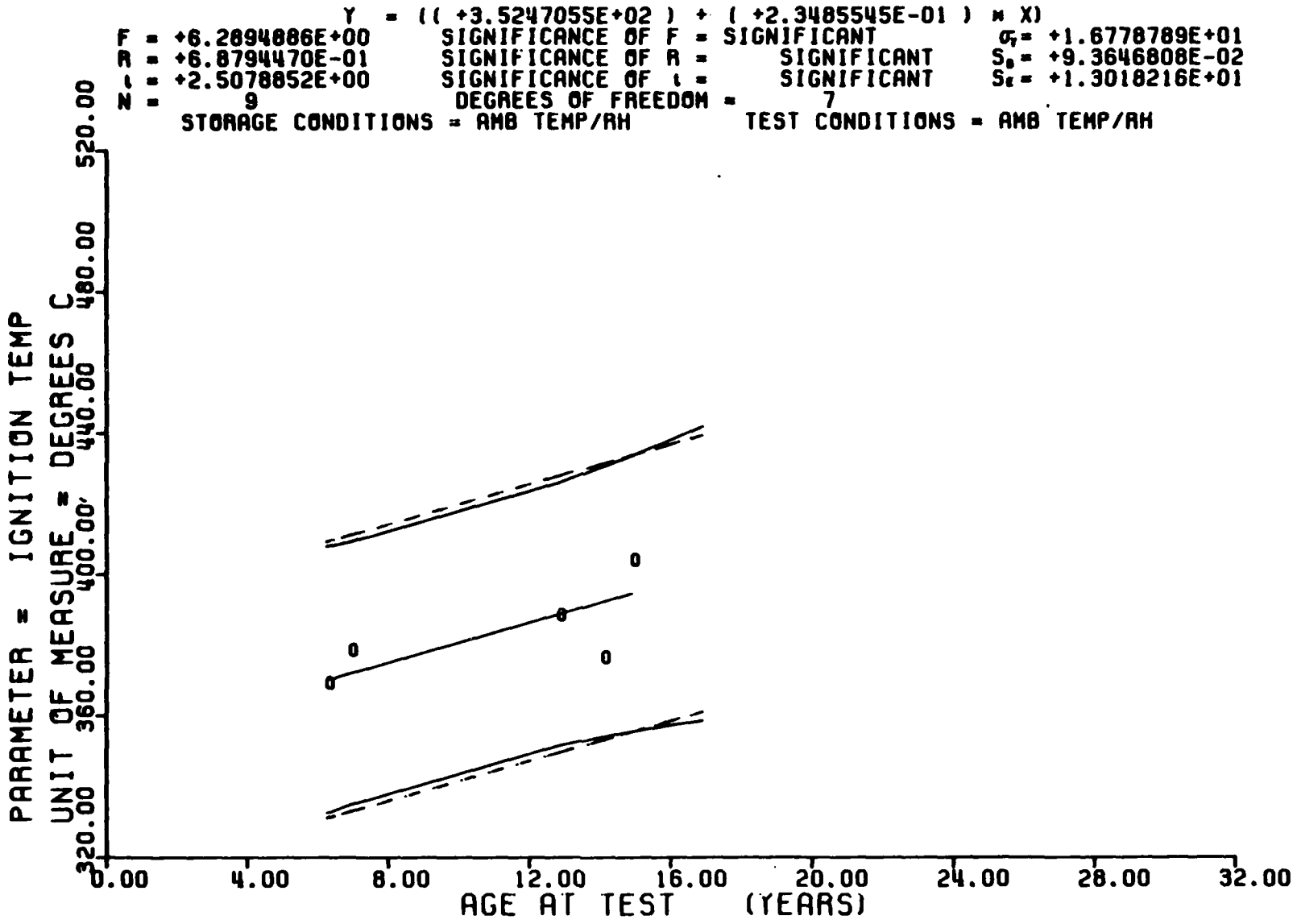

Y = ((+3.5247055E+02) + (+2.3485545E-01) * X)
F = +6.2894886E+00 SIGNIFICANCE OF F = SIGNIFICANT σr = +1.6778789E+01
R = +6.8794470E-01 SIGNIFICANCE OF R = SIGNIFICANT Se = +9.3646808E-02
t = +2.5078852E+00 SIGNIFICANCE OF t = SIGNIFICANT Sa = +1.3018216E+01
N = 9 DEGREES OF FREEDOM = 7
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = IGNITION TEMP
UNIT OF MEASURE = DEGREES C
320.00
360.00
400.00
440.00
480.00
520.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,DISSECTED MTR=(0)0012099,DTA,IGNITION TEMP,12 DEG C RISE/MIN.

Figure 53A

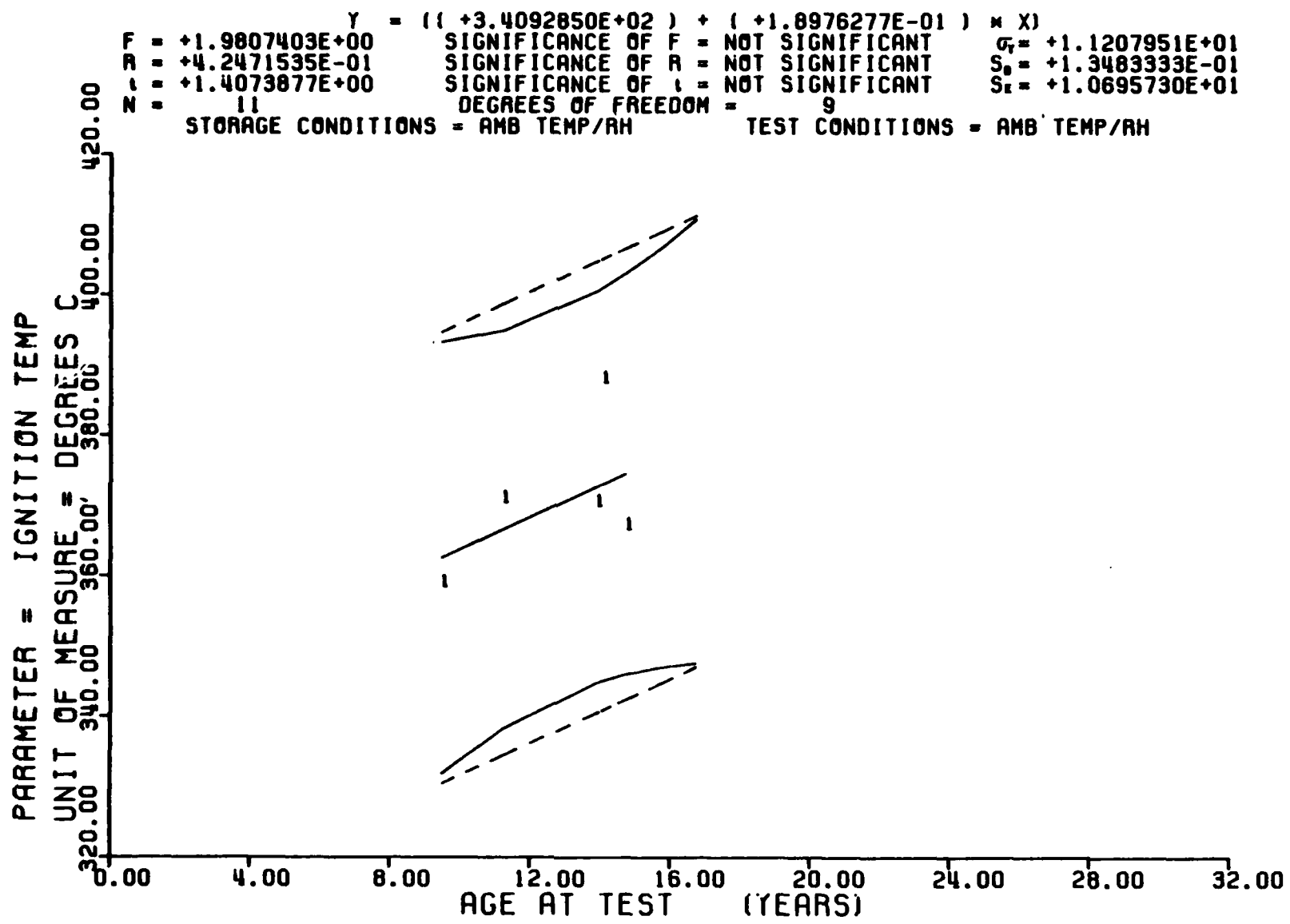

Y = ((+3.4092850E+02) + (+1.8976277E-01) * X)
F = +1.9807403E+00 SIGNIFICANCE OF F = NOT SIGNIFICANT σY = +1.1207951E+01
R = +4.2471535E-01 SIGNIFICANCE OF R = NOT SIGNIFICANT Se = +1.3483333E-01
i = +1.4073877E+00 SIGNIFICANCE OF i = NOT SIGNIFICANT Si = +1.0695730E+01
N = 11 DEGREES OF FREEDOM = 9
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = IGNITION TEMP
UNIT OF MEASURE = DEGREES C
320.00
340.00
360.00
380.00
400.00
420.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,DISSECTED MTR=(1)0012199,DTA,IGNITION TEMP,12 DEG C RISE/MIN.

Figure 53B

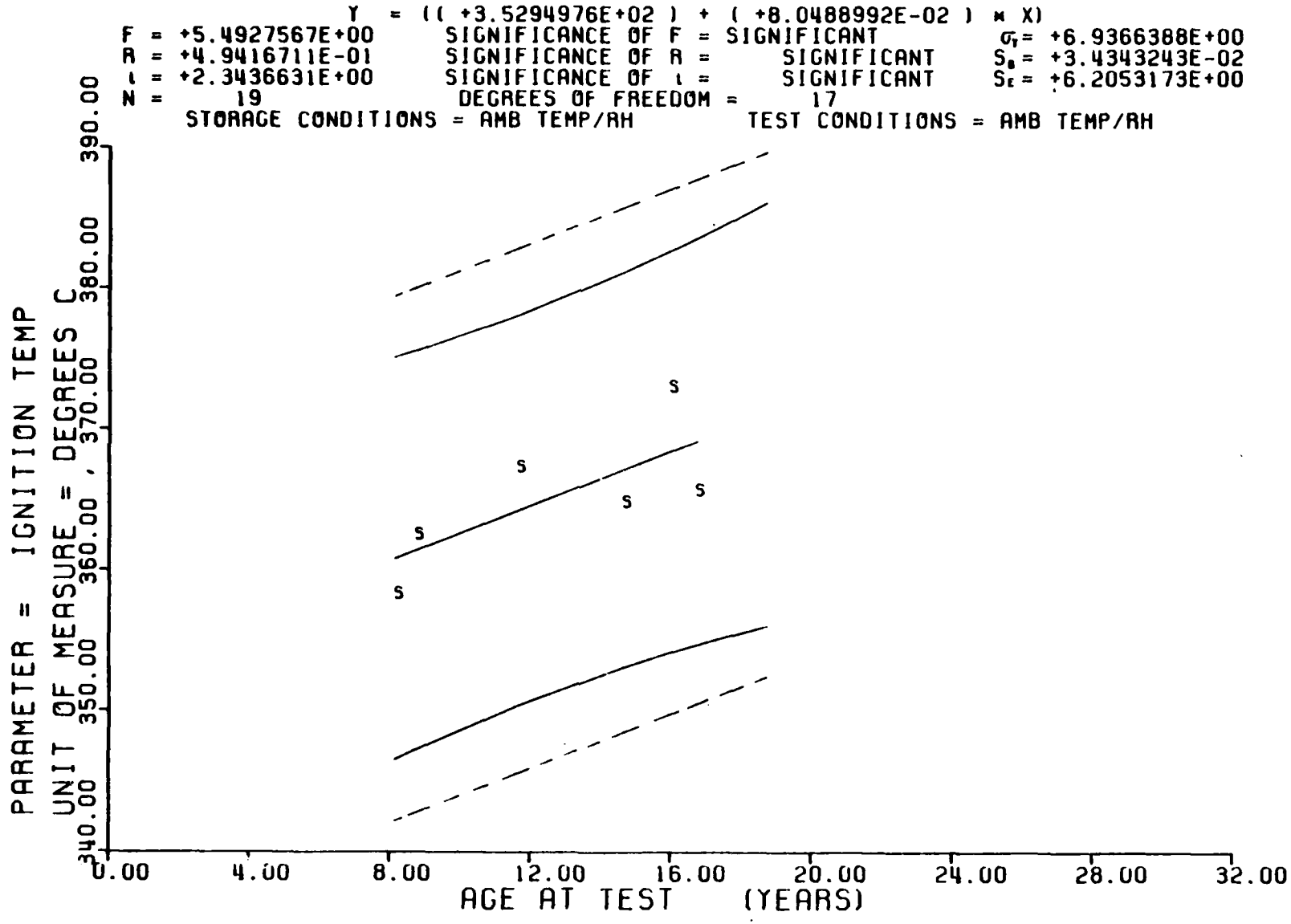

Y = ((+3.5294976E+02) + (+8.0488992E-02) * X)
F = +5.4927567E+00 SIGNIFICANCE OF F = SIGNIFICANT σ1 = +6.9366388E+00
R = +4.9416711E-01 SIGNIFICANCE OF R = SIGNIFICANT Sa = +3.4343243E-02
t = +2.3436631E+00 SIGNIFICANCE OF t = SIGNIFICANT Sε = +6.2053173E+00
N = 19 DEGREES OF FREEDOM = 17
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = IGNITION TEMP
UNIT OF MEASURE = DEGREES C
340.00
350.00
360.00
370.00
380.00
390.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
S
S
S
S
S
STAGE 1,DISSECTED MTR=(S)STM-012,DTA,IGNITION TEMP,12 DEG C RISE/MIN.

Figure 53C

DISTRIBUTION

	NR COPIES
OOALC	
MMWRBM	1
MMWRAM	1
DDC (TISIR) Cameron Station, Alexandria, VA 22314	2
SAMSO, Norton AFB, CA 92409 Attn: Mr. Sanford Collins, Bldg. 562, Room 613	1
AFPRO, Thiokol Chemical Corporation Wasatch Division P.O. Box 524 Brigham City, UT 84302 (Cy to Larry Hales)	2
AFRPL (MKPB) Edwards AFB, CA 93523	1
SAC (LGBM) Offutt AFB, NB 68113	1
U. S. Naval Ordnance Station, Indian Head, MD 20460 M. E. Loman, Code 3012A4 Air Launched Weapons Branch Weapons Quality Engineering Center	1
CPIA, Johns Hopkins University Applied Physics Lab John Hopkins Road, Laurel, MD 20810 Attn: Mr. Ronald D. Brown	1
Naval Plant Branch Representative Attn: Mr. David W. Pratt P. O. Box 157, Bacchus Works Magna, UT 84044	1

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER MANPA Report Nr. 482(83)	2. GOVT ACCESSION NO. AD-A139201	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Surveillance Report, Stage I Dissected Motors, Phase		5. TYPE OF REPORT & PERIOD COVERED Test Results - Semi Annual
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) JOHN A. THOMPSON		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Propellant Analysis Laboratory Directorate of Maintenance Hill AFB, UT 84056		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Service Engineering Division Directorate of Materiel Management Hill AFB, UT 84056		12. REPORT DATE December 1983
		13. NUMBER OF PAGES 120
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for Public Release, Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Minuteman
Solid Propellant

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Testing was performed to determine the useful shelf/service life for LGM-30 Stage I Rocket Motors. A three'year storage program for propellant and components was started in May 1961. This program was then extended to a ten year study and later continued indefinitely to assure that a deterioration in motor physical characteristics could be detected in time to take some corrective actions before the weapon system performance deteriorated below an acceptable level.

DD FORM 1 JAN 73 1473

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

This report covers only propellant data and limited case bond data. The malfunction of an environmental chamber destroyed component samples that had originally been part of this testing program (and the inadvertent burning of some motors during dissection reduced the material available for testing). Planned dissection of selected motors in the future will provide samples for continued component testing. Test specimens for this reporting period were obtained from motors STM-012, 0012099, and 0012199. UP-7775 block propellant was not tested since that propellant has been used up.

A new technique of Multi-symbol Regression Analysis was used to determine aging trends. Also, using a unique plotting code for each motor tested demonstrates the relationship between motors and block propellant. The plotting symbols for each motor and block propellant are listed in the statistical analyses section.

The data from this test period was combined with data from previous testing and entered into the G085 computer for storage, analysis, and regression analysis. From the statistical analysis of all data tested to date, significant degradation of the propellant does not appear likely for at least two years past the oldest data point.

Future testing will be conducted on dissected motors.